CHEMICAL & METALLURGICAL ENGINEERING

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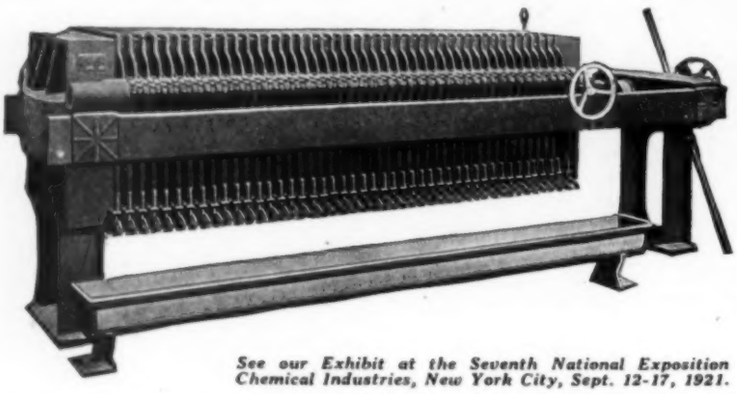

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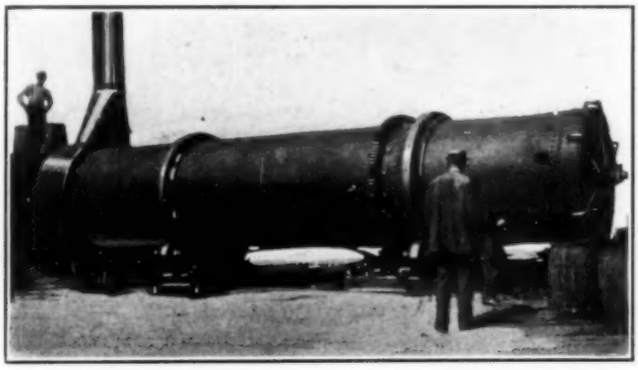

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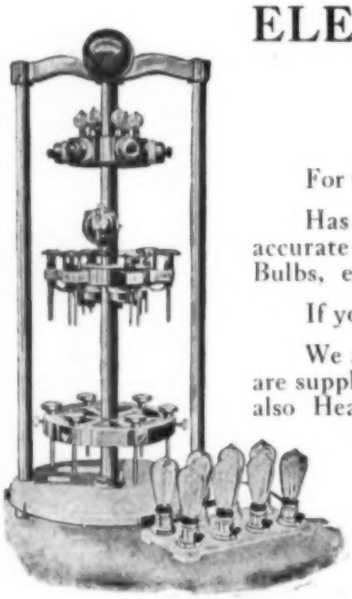

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The Facts About American Dyes

THE other day we heard an estimable gentleman fulminating about dyes. He is a large wholesaler of cotton goods and he protested with vigor against this hullabaloo that is being made to keep German dyes out of the country while the very kind that is needed for his goods—to wit, vat dyes of the indanthrene type—are not made here.

We delivered a little reply about the anthracene base of most of them, told how pitch with the anthracene extracted does not seem available for roads and roofing, but that abroad, where pitch is largely used as a binder for coal briquets, the extraction of anthracene made no difference, but we felt that our reply was weak. Indeed it was weak, for we subsequently learned that there is plenty of anthracene available in this country but that manufacturers of dyes generally do not know how to use it. From what we can learn it appears that no American manufacturer has thus far succeeded in making, successfully and economically, a full line of the special type of vat dyes generally known by the German trade names of "indanthrene," "ciba" and "algol" colors. Their special use is for such cotton goods as shirtings. All the other colors with the exception of some of the related alizarines are made here in quantity and of standard quality. Vast amounts of indigo of supreme quality and a number of true alizarines of domestic manufacture are at hand as vat dyes. The only real hitch has been in those of the indanthrene type and we are assured that two American concerns are making a few indanthrene colors that are wholly up to standard and that they are producing them in quantity. The full line, however, has been "coming along" for five years, and experience teaches us to be conservative in waiting for them.

But why worry! *The very vat dyes which are needed are today being imported in large quantities under license!* There is no shortage of any kind of dye needed by American textile manufacturers, either in quantity or in quality. Not only the old dyes but even the new ones are available.

Then what is the trouble? We think it would have been better if the makers of dyes had been as frank in admitting their failures as they have been in telling their achievements, but this habit of frankness has not yet been incorporated into the *mores* of American industry. And it is not the cause of the present discontent. The discontent comes from improperly dyed goods. And why are improperly dyed goods offered for sale? The answer is the same as that given after mature thought by an old elder in the Bible class when the dominie asked him why GOD hardened PHARAOH'S heart. "He had," replied the elder, "various reasons."

Now among our various reasons is the cost of labor. One dip costs less than several dips, and the high wages paid to dyers induce many textile manufacturers to take the shortest cuts to get results irrespective of quality. This, we believe, is a leading reason. Then, too, there used to be a nasty situation in dye houses in that dyers wanted bribes—and got them in profusion. They don't get them any more, and this may have a bearing. Again there used to be German competition, and the Germans are good dyers. There are just such good standards of quality on the market today, but the public does not know the trademarks. Sulphur black is plentiful and cheap, and no better sulphur blacks were ever made than are made by a number of American concerns. Plenty of dyers can and do apply it. But direct black, which does not hold so well in the wash, may be put on at less cost, and one pound of it will take the place of two or three of sulphur black. And here a new cause of trouble appears—drygoods pass through many hands before they reach the retail counter, and the converter who handles the goods may have little more than a cent a pound margin in the transaction. He therefore orders the material dyed at the lowest cost, and the cheapest goods win out with the buyers. So the fault is not alone with the dyer. A good part of the blame rests with the manufacturer, the converter, the jobber, the wholesaler and the retailer as well.

As for woolens and silks, there has been no shortage of any dye needed for years. Light, delicate shades never were fast to light, they are not now and there is no promise of their becoming so. But 1914 was seven years ago and people forget a great deal in seven years. One of the things they have forgotten is that such garments used to fade.

So we come back to the statement which we reaffirm—that every dye, the use of which has not been given up because of its defects, is available to the American dyer today. In addition to this there are a few new and better dyes to be had which were not procurable before the German war. Still more, American dyers are proficient in their art; not all of them, perhaps, but the proficient ones are here and they know how to get the best results obtainable. Improperly dyed goods are on the market and they are offered because there is more profit in them for somebody than there would be if the best that can be had were offered. If the statement is made that "We cannot guarantee these goods as to color because German dyes are not available," it is false. It is made either in ignorance or in cupidity. It may explain the price or the ignorance of the buyer, but it does not state a fact.

The American public buys on finish rather than on intrinsic quality. Whenever it demands quality and insists on it, it can have it. Duty-free dyes would not give us cheaper or better clothing. Duty-free textiles would, but do we want duty-free textiles?

Fundamental Conceptions Underlying Metallurgical Advance

TECHNICAL literature and scientific transactions—at least as far as metallurgical science is concerned—seem now to be almost exclusively occupied with quality rather than quantity of output, with inquiry into hidden causes rather than exposition of their effects. One ton of metal of excellent properties, great reliability and endurance is apparently more interesting than 600 tons of ordinary stuff. Investigators are more interested in the one condenser tube which fails than the thousands which prove satisfactory in every way. Research men are borrowing the utmost resources of physics and chemistry to discover the mechanism of so common an occurrence as a breaking axle.

But are these investigations, these accounts of failures, these lists of physical properties, descriptions of laboratory manipulations, and speculations about things too small to be seen in the microscope, are these things of any real value to work-a-day life? Are they more than mere star gazing, not worth the paper they are printed upon?

Undoubtedly they are of value, if for no other reason (and there are many others) than that from them will emerge, some time, somehow, the idea whose development and wide application will be the mainspring of the next epochal movement in metallurgy. It would not be surprising if that idea has already been born!

It seems to be a fact that civilization moves forward in sharp rushes—advancing a certain detail very rapidly from a position which it had maintained for years, even centuries, to another position of advantage and apparent rest, only to be followed by a further striking advance on some other sector. Ancient Egypt furnishes an early example. Savants affirm that the Egyptians found something, no one now knows what it was, but they thought out some great idea, which in not more than a short century led that people forth from the place where they were barely able to range a few stones around their dwellings as rough boundaries or defences, to the pinnacle of skill in cutting, fitting, transporting and building huge blocks of granite into pyramids and sphinxes.

Last century it dawned upon some men in the iron trade that mechanical handling could be applied to metallurgical processes, and in twenty years JOHN FRITZ, HOLLEY, BROWN and WELLMAN (to mention but a few) led that remarkable "Duquesne Revolution" which increased the capacity of blast furnaces and steel mills one hundred-fold. We could build them bigger, but what's the use? They would lose flexibility, or rather adaptability, and be more than ever subject to intermittent operation, with consequent interest and overhead charges mounting to ruinous proportions.

So, it may be repeated, metallurgists have been for some years groping, somewhat haltingly, for the new idea which will carry them forward on the next advance. But has not the new conception already been dimly seen?—the realization that physical properties and reactions must be interpreted in terms of forces acting between atoms, even within the very structure of an atom.

How else can the field of alloying, stupendously great, almost uncharted, without apparent form, a tangle, be mapped out and comprehended? What else is common to such widely divergent things as hardest tool steel and softest lead, toughest copper and most brittle tungsten, infusible calcium and liquid mercury, the corrosion of metal and the smelting of ore? Fundamental hypotheses and theories four-square with our ever widening knowledge of the atom itself are the only ones which will allow the tremendous mass of experimental information to be classified and truly understood, but, more important still, will enable one to predict with fair accuracy the expected result of a hopeful investigation—to steer a course which will lead to those new discoveries and valuable improvements which will form the milestones of civilization's advance.

Suggesting a New Branch of Chemistry

WE HAVE so many kinds of chemistry—inorganic, organic, physical, colloid, photo and such a lot more—that it will scarcely do harm if we add still another division, and for this we propose the term Credulochemistry. It is published almost exclusively in daily newspapers, and is, in effect, chemistry that isn't so. A few years ago it flourished more actively than it does now, but we still have remarkable manifestations offered for study. A curious feature is that contributors to this amazing field of research are almost invariably wholly ignorant of science. They do not have to reason or think; they just make "expurments."

The latest step in credulochemistry we gather from the New York *Herald*, but it was also published as a news item in several other leading journals. This "special despatch" was dated Laporte, Ind., and it set forth the news that WALTER BUNTON, twenty-eight years old, a war veteran with a wound stripe, employed by the New York Blower Co., had discovered the "lost art" of hardening copper. This is a favorite stunt, and has been discovered so many times that it seems a pity that, after all the inventions, copper isn't really any harder than it is.

Mr. BUNTON of the Blower company seems, according to the report, to have had better luck. First he found an ash-can in which were some leaves of an encyclopædia which told of "an ancient metallurgist, incidentally a murderer, with whose death the secret of hardening copper was lost." Then he proceeded to experiment, and, presto! there was his metal which, according to the *Herald*, "is said to be the hardest metal known, except for one called 'Steelite,' (*sic*). It means cutting tools for lathes that will not strike sparks . . . . electric motors and generators that will not burn out"—it means, in other words, an awful lot. Then he went to Gary, Ind., and saw Judge GARY, showing him his discovery, and he, as soon as BUNTON finished talking, said: "Name your terms."

(Now isn't that just like Judge GARY?)

BUNTON replied: "One million dollars . . . and two cents a pound royalty."

"We will let you know. Good day," answered the chairman of the board of the U. S. Steel Corporation, and on Friday, the paper says, "a letter came accepting the terms." The account closes with, "BUNTON is to be married in October." That gives it what they call on the stage "the heart interest."

Now the people at the Steel Corporation do not know anything about this great find and strategic purchase, and neither does anybody else as far as we can find out. It is merely an eruption of credulochemistry. A study of its origins would be interesting. But we wish they would stop hardening copper.

Russian Chemists And Organic Chemistry

IN A monograph on "The Chemistry of the Non-Benzenoid Hydrocarbons," by Dr. BENJAMIN T. BROOKS, which will soon be published, over half the citations refer to work by Russian chemists. We need to be reminded of the splendid work, the masterful research in chemistry, more particularly in the organic field, which was in progress in Russia when the German war began. Where are those men now? What are they doing? Have the Soviets put them to work sweeping streets because it required capital to prosecute chemistry and therefore the science itself is a phase of wicked capitalism? Where are IPATIER, KISHNER, MARKOWNIKOV, KANOWALOV, ZELINSKY, BREDT, OSTROMUISTESENSKI, LEBEDEV and CHARITSEKOV? Where is P. WALDEN, who was here in 1912? The rubber industry is in a bad way, and research is the best cure for bad times. Wouldn't it be a good plan to send out a search party to find OSTROMUISTESENSKI? His contributions to the chemistry of rubber have been of high rank, and his splendid talent and understanding would be a godsend to the industry. If these men are not at work at their chosen calling it would be an investment of supreme value to find them and to provide opportunity for them. It is no reflection on American chemists to say that these Russians are needed. Talent is always needed in science, and men with a real vision of chemistry have to be born as well as made. We cannot induce the quality by fluttering a flag over their mothers' childbeds. The Germans thought they could and that chemistry was Kaiserlich-Königlich-Deutsch, but they found out their mistake. As soon as we begin to think that American chemists are the only pebbles on the beach, it will be sunset time with us.

Relations In Wage Rates

THE decision rendered last week by Judge LANDIS in the Chicago building trades dispute is interesting from several viewpoints. When first solicited to act in the matter Judge LANDIS refused to undertake to set wage rates as long as certain working conditions were allowed to continue. Various changes were then made in the rules, in the direction of efficiency, and Judge LANDIS consented to act in the matter of rates. It is well that the conditions making for waste in building operations in Chicago were thus emphasized and that some correction has been applied. There cannot be too much publicity given to the extravagant waste of time and wages that has characterized building operations in many centers.

In CHEMICAL & METALLURGICAL ENGINEERING of July 27, 1921, reference was made to statistics gathered by Dr. RALPH G. HURLIN, statistician of the Russell Sage Foundation, covering commodity prices and wage rates for a century or so. It was shown that from 1820 to 1910, while wages in general almost trebled, the wages of five selected classes of artisans ran quite uniformly at 80 per cent above the rate for common labor. In the past few months we have seen common labor receiving 25 to 30 cents an hour in many descriptions of work in various parts of the country, while artisans were demanding a dollar or more an hour. This brought up the question whether conditions had changed from those that ruled for perhaps a century or longer, so that skilled labor should now be worth more than formerly in terms of dollars in relation to common labor. Considerations that are obvious would suggest a contrary conclusion.

In this connection the award of Judge LANDIS is of particular interest. Eight of the skilled crafts involved will receive less than 85 cents an hour, while a few will receive a trifle more than a dollar. "Common labor" is evidently defined peculiarly in the Chicago building trades, for the reports show that Judge LANDIS has set at least four rates for different classes of common labor, 47½ cents, 50 cents, 70 cents and 72½ cents. A common labor rate of 50 cents and an average of 90 cents for skilled labor would show the 80 per cent relation of skilled over common labor that Dr. HURLIN'S statistics indicate is worthy of much respect. A curious point is that the previous standards in Chicago were $1 for common labor and $1.25 for skilled labor, showing a 25 per cent premium for skill instead of 80 per cent. One experiences no difficulty in concluding that the wages were due to membership in unions and the restrictions that had been thrown about building operations. One could work this out by some very simple algebra, but it is not necessary to set down the equations. Take 31 cents for common labor and 56 cents for skilled labor, which makes the latter approximately 80 per cent above the former. Then add to each rate 69 cents an hour as the part played by the unions and one has $1 for common labor and $1.25 for skilled labor.

Salvage for The Wise Ones

> There is a certain frame of mind to which a cemetery is, if not an antidote, at least an alleviation. If you are in a fit of the blues, go nowhere else.—*Stevenson.*

PATIENT men will amusedly tolerate the talk of the fellow in these days who propounds a philosophy of optimism unsupported by facts. The most imperturbable man, however, loses all control in the presence of the individual carrying the morbid mien in bad industrial weather and mounting fleecy clouds to air castles during periods of booming business.

Last year this latter chap vowed the sunny season would never end because it was upon us. It has taken a period of hard depression to convince him to the contrary until now he is just as certain that business will be bad for the next decade. The pitiful thing about the whole situation is that his type is in the majority and is found even in our so-called big business circles. Were the advice of STEVENSON taken seriously, the burying grounds of this country would have no standing room available.

Keen thinkers are not talking so much about the good times coming, but realizing that the worst has happened in many industries, are quietly preparing to reap a profit from the weak-hearted ones. Opportunely purchasing failing business enterprises, stocking up on materials and equipment at bargain prices and slowly building up organizations for the future harvest are all a part of their plans. Accumulating economic goods on a lowered tide, they will witness the same old spectacle of their ships coming in with the full flood of industrial prosperity and the graveyard artist, now become a horntooter, standing by anxious to purchase the cargoes at the highest figures.

The repetition of the sun-moon ocean tide is no more certain than the return of prosperity in the greatest creditor nation.

MEMBERS AND VISITORS, CANADIAN MEETING, SOCIETY OF CHEMICAL INDUSTRY

1—Dr. J. P. Longstaff, secretary of the society. 2—Dr. R. F. Ruttan, president of the society. 3—Sir William Pope, K.B.E., F.R.S., retiring president. 4—E. F. Smith, president of the American Chemical Society. 5—William H. Nichols, past president of the American Chemical Society. 6—T. H. Wardleworth, vice-president of the Society of Chemical Industry. 7—C. S. Garland, A.R.C.Sc., chairman of Lighting Trades, Ltd., and vice-president of the Society of Chemical Industry.

Canadian Meeting, Society of Chemical Industry

Large Number of Delegates From Great Britain and Visitors From the United States Gather in Montreal and Later Experience the Hospitality of Various Sections of Canada—Dr. R. F. Ruttan Elected President—Summary of Papers Presented

THE extended tour of the delegates to the annual meeting of the Society of Chemical Industry was concluded on Sept. 7, and we give below a short summary of the principal events, of the papers and discussions and of other features in the itinerary. Photographs and particulars of the principal delegates have already appeared in these columns. Some were prevented at the last moment from attending, these including the Hon. Treasurer of the society, E. V. Evans, and Dr. MacWilliam, the well-known metallurgist of Sheffield. Additional members of the party are Peter Kerr, chemist to the Shell Mex interests, W. Gordon Adam, of the Gas Light & Coke Co., and Keith Benham, managing director of the Universal Grinding Wheel Co. of Stafford.

The passage on the "Melita" was uneventful and good weather enabled the ship to establish a record crossing of some hours under seven days to Quebec.

The delegates' reception at Quebec was of the most cordial and hospitable description, and it is really extraordinary how much the party was able to see of Canada in a very short space of time, thanks to the admirable arrangements which were made. Visits to Ste. Anne de Beaupré, the Golf Club, Kent House, Montmorency Falls and the battlefields constituted, with Sir George Garneau's dinner at the Garrison Club, the first day's program, while on Saturday the Lieutenant-Governor's luncheon at Spencerwood was a really notable occasion in the happiest of surroundings. In the afternoon the party left for the Manoir Richelieu, Point-a-Pic, Murray Bay, and the beautiful surroundings and invigorating atmosphere of this delightful resort did much to cement the intimate and cordial relationship which had already sprung up between the delegates and their Canadian hosts.

Incidentally, progress was made in arranging the following week's program and certain departures from a somewhat hidebound precedent were necessary in conducting a meeting of this kind in another continent.

The Annual Meeting

The annual meeting was held at McGill University on Aug. 29, and it was announced that more than 225 members of the society had registered at the Chemistry Building. In addition to the British visitors several notable American chemists were also present, including Dr. Edgar F. Smith, president of the American Chemical Society; Dr. C. H. Herty, and Dr. W. H. Nichols, president of the Allied Dye & Chemical Corporation. Theodore Wardleworth, the chairman, called on the Rt. Hon. Sir Charles Fitzpatrick, K.C.M.C., Lieutenant-Governor of the Province of Quebec, who extended a hearty welcome and a personal message of good will from the Prime Minister of the Dominion. Sir Charles eulogized the work that the members of the society had done during the war and expressed the hope that the same high ideals would animate them in their reconstruction tasks.

At the request of the Canadian Section, and of its three branches, the Section has been dissolved and separate sections have been established at Montreal, Ottawa and Toronto. A new section has also been formed at Shawinigan Falls, so that the society has now five Canadian sections—namely, at Vancouver and at the four centers above mentioned. There has been formed an executive committee for Canada, consisting of the chairmen and secretaries of the five sections, to arrange for the annual convention of chemists and to take charge of matters affecting the Canadian chemical industry.

A conference on the standardization of chemical plant was held at the Institution of Civil Engineers in July, 1920. It was attended by representatives of government departments and of scientific bodies interested, including the Society of Chemical Industry. It was unanimously recommended that a Chemical Engineering Committee of the British Engineering Standards Association should be set up, and this was subsequently approved. The representatives of the society on this committee are Prof. Hinchley, Capt. Goodwin, Mr. Reavell, Mr. Garland and Dr. Ormandy.

1—Group of some of the party on S. S. Melita.
2—Chief Justice William H. Taft at Murray Bay.
3—Dr. R. F. Ruttan, Chief Justice Taft, Sir William Pope.
4—Dr. R. F. Ruttan, president Society of Chemical Industry.
5—Sir William Pope, retiring president of the society.
6—Dr. J. P. Longstaff, secretary of the society.

President's Address

Sir William Pope, the retiring president, brought out forcibly the good effects resulting from the co-operation of all the peoples of the British Empire and dwelt especially on the part played by the great Dominion of Canada. He then outlined the wide field covered by the society, and after mentioning that the society's financial status is now quite satisfactory and that great strides are made by the Council and publication committee to broaden the scope of the *Journal of the Society of Chemical Industry*, he spoke with enthusiasm about the great problems now confronting the British chemical industry. He said in part:

"Seven years ago the situation and the outlook in all branches of scientific industry were very different from those which now confront us. In 1914, certain of the chemical industries of Great Britain were expanding slowly but steadily, while others were slowly but just as surely shrinking before foreign competition; in some of the chemical industries Great Britain was supreme, but in others we were losing ground. The interval has seen the commencement and the conclusion of a great conflict, a war which has reduced to mediocrity several of the dominant European powers, and has left nearly every nation struggling under an accumulation of debt.

"The problem now is an entirely novel one in that it is accompanied by certain factors which were previously absent or which were at any rate of subsidiary importance. Thus it cannot be doubted that the bonds uniting all parts of the British Empire have become far stronger in consequence of the events of recent years; further we realize to a greater extent than ever before that for purposes of production our empire must be, if not absolutely self-contained, at least in possession of modes which could be rapidly mobilized so as to render us self-contained.

"In the past we have, I venture to think, endeavored to build up our chemical industries far too much on the lines which proved so fruitful in Germany. I am speaking now not of the heavy chemical industry, in which we have always been to the fore, but of those industries which involve the production of the use of a great variety of more or less complex organic compounds. The organic chemist has long had before him, as one great object of his work, the artificial production of the myriads of organic compounds which we find among animal and vegetable products; he may be justly proud of his achievements in this direction and the success attained justifies our belief that we shall within quite a short time be able to prepare in the laboratory any compound substance formed by the animal or plant. Immediately some important natural product of commercial value is produced in the laboratory, the German technologist has sought to convert the laboratory method into a works process capable of competing with that of the plant or animal.

"My point in suggesting that we have erred in adopting German views concerning the methods and aims of chemical technology, without reflecting that economic conditions in Central Europe are entirely different from those which prevail in the British Empire regarded as a whole, perhaps calls for some explanation. The object of all technology consists in coverting raw materials of inorganic origin into products of greater value by expending upon them a certain amount of labor, and a certain amount of energy. To a Central European nation labor means high wages to its population and energy means mainly coal or waterpower; only one type of technological process is thus in the main to be considered, and this is one in which certain raw materials enter the works to be handled by costly labor and to be treated by the burning of fuel, which is another form of costly labor.

"We have other methods for obtaining similar results, methods which are available in many cases but have been worked out in only a few cases."

He cited the specific example of the synthetic india rubber made in Germany as compared with the natural

product from the plantations in the British territory and added:

"It would not be fair to depreciate the installation of synthetic methods for manufacturing complex natural products. Nature in general furnishes us with but one very complex member of any particular class of organic compounds. Thus the numerous plants which produce indigo yield but minute proportions of other compounds of a similar type and, in this instance, the chemical technologist has succeeded in manufacturing a whole range of valuable dyestuffs of the indigo family which do not occur among vegetable products; his efforts have to this extent been amply justified, but it is difficult to believe that synthetic indigo itself would ever have been able to compete in the market if a similar amount of scientific skill and intelligence had been devoted to the improvement of the cultivation and atilization of the indigo plant. The work which is now being done by Armstrong, Davis and others on natural indigo may well result in the re-establishment of the Indian indigo plantations.

Application of Low Potential Energy

"The last century has witnessed two great phases in the development of practical chemical work. Roughly speaking, it may be said that the progress of chemistry up to about forty years ago, great though that progress was, resulted from the application of rather fierce methods; a time came, however, when it was recognized that much was to be learnt, especially in organic chemistry, by the study of delicately balanced reactions in which the practical methods applied were devoid of violence and in which conditions, such as concentrations, temperatures and the like, were carefully controlled. The organic chemistry of to-day does not distill fragile organic compounds through red-hot tubes; it proceeds by more subtle methods which, nevertheless, have greatly developed the broad knowledge of the science bequeathed to us by our predecessors. In its adoption of milder modes of operating and its consequent application of energy at a low potential, organic chemistry is approximating in its laboratory methods to those which occur in plants and animals; but the chemical changes which occur during the course of animal or vegetable life are still far more complex than those brought about in the laboratory. This complexity doubtless arises from the utilization of low potential energy in the living organism; temperature changes of more than 1 deg. C. are not permissible in the healthy animal organism. The great majority of the chemical reactions which take place in living matter occur catalytically in colloidal media.

"While the first great epoch in the history of organic chemistry was marked by the application of violent experimental methods, the second developed milder modes of procedure; the third epoch, which is in course of inauguration, will bring us into direct competition with the experimental chemical methods practiced by living matter. It is impossible to doubt that a vast expansion of organic chemistry will be witnessed by many of us, an expansion which will result from an imitation of the gently effected chemical operations carried out in the animal and vegetable creation.

"While this prophecy is not a mere surmise as to the nature of the next step forward to be taken by the science of organic chemistry, but is rather of the nature of a logical deduction from past events, it is perhaps surprising that more use has not been made of the chemical methods of living matter for technological purposes."

He then directed attention to the fact that up to the present far too little progress has been made in the direction of combating the different types of parasitic vegetable and animal life, and finally spoke on the pressing need of a better use of the petroleum resources.

In moving a vote of thanks to the president, Dr. R. F. Ruttan, in a happy speech, referred to the progress made in the application of biochemistry to industry in recent times, instancing the Weizmann and Fernbach processes of starch fermentation for the production of acetone and the successful way in which these and the synthetic production from acetylene had been carried through at Shawinigan Falls.

Officers Elected, Luncheons and Banquet

The remainder of the business was of a purely formal character and a luncheon followed at the Ritz-Carlton Hotel under the chairmanship of Dr. Milton Hersey, at which a civic welcome was extended by Dr. Dubeau on behalf of the Mayor of Montreal.

On the following day H. W. Matheson of the Shawinigan Company presided over a luncheon at the Windsor Hotel at which Sir F. Williams-Taylor was the guest of honor. Sir William Pope took the opportunity of addressing the members of Rotary Club of Montreal at the same time and gave them a digest of his writings on the future of gas warfare and its relative merits and efficiency as against other forms of destruction. The banquet took place at the Engineers' Club.

The officers elected are: President, Dr. R. F. Ruttan; vice-presidents, Dr. J. L. Barker, C. S. Garland and Sir William Pope; members of the Council, H. Allan, F. Armstrong, J. W. Hinchley and J. D. Wilcock.

Technical Sessions

At the technical sessions papers were presented by speakers prominent in their various lines.

Need for Reform in the Education of Chemists

Prof. Lash Miller, speaking on the need for reform in the education of chemists, pointed out that far more students were taking up chemistry than were dreamed of a few years ago. The training given them is the same today as it was when chemistry was a purely experimental science. There is need for reform of chemical language, to make terms and formulas mean something to the students learning them.

The Laurentide High-Speed News Machine

A paper on the Laurentide high-speed news machine, by George D. Kilberry, was read by J. L. Stephenson.

The new 166-in. news machines installed in the Laurentine Company's mill at Grand Mere, Que., probably represent the very best effort heretofore applied to the design and construction of news machines, and the recent results obtained amply justify the Laurentide Company in believing that it has reached the goal selected—namely, marketable paper at 1,000 ft. per minute or better as a continuous operation.

These machines embody no new principle in paper making, but have some features of design not common to most machines, chiefly the method of putting on new wires, the application of suction couch and suction press rolls, the novel arrangement of compressed air jets for passing the tail or ribbon of paper from couch to press and between the presses as well as at the

calenders and reel and a very generous use of ball bearings at the wet end of the machine.

The fourdrinier part of the machines is constructed without the usual shaking arrangement, as it has been demonstrated that there is no more need for shake on a news machine than five wheels on an automobile.

The Action of Thiocyanates on Cellulose

R. H. Clayton read a very important paper on "The Action of Thiocyanates on Cellulose" by R. H. Clayton and H. E. Williams. The contention of their paper is that solvents for cellulose must have the following specific properties:

1. High solubility in water.
2. High boiling point in concentrated solution.
3. Suitable viscosity and of a positive, but not too great, heat of dilution.
4. Mixed salts not to react chemically.

Diagrams showing the correct conditions were shown and explained.

Of all the cellulose solvents examined, calcium thiocyanate is the most suitable; it has the further advantage of being derived from a cheap base, and hence has been most considered from the industrial standpoint.

Following the discussion on this paper a moving picture of the manufacture of paper showing the complete operation from the tree in the forest to the roll of finished paper leaving the mill was presented by A. L. Dawe, secretary of the Pulp and Paper Association. This film depicted the operation at Price Bros.' plant, Kenogami, Que., and is considered one of the finest industrial films that has ever been taken.

Properties of Pure Hydrogen Peroxide

Dr. O. Maass' address dealt with the preparation and properties of 100 per cent peroxide, a research carried out at McGill University.

Hydrogen peroxide is the name commonly applied to an article which may be procured in any drug store, but this really consists of a 3 per cent aqueous solution which generally contains as well inorganic salts, a little acid and other impurities. The water and other impurities are removed in three stages. The first consists of a vacuum concentration and distillation to a 35 per cent pure aqueous solution, this is then concentrated to a 90 per cent solution and the latter subjected to fractional crystallization on the end product of which is the 100 per cent. Special apparatus was designed for this work, including a sulphuric acid pump, which alone made it possible to obtain large yields. Strong solutions of hydrogen peroxide were prepared in the past and were reputed as being highly explosive and several serious accidents are recorded. This instability is due to the presence of impurities. Pure acid-free hydrogen peroxide is not explosive.

Observations on the Chemistry of Rubber

In "Some Observations on the Chemistry of Rubber" Prof. G. S. Whitby touched on a variety of points of interest in the researches which he and his co-workers have recently conducted at McGill University into the chemistry of raw rubber and the vulcanization of rubber. He described an investigation of the resin of rubber, which represents the first successful attempt to elucidate in some degree the problem of the chemical nature of a constituent of raw rubber which, although present in only a small proportion, has an important influence on the behavior of the rubber when the latter is vulcanized and in other ways. Dr. Whitby's investigations show that a considerable number of crystalline substances can be isolated in small amounts from raw rubber. One of these substances is an interesting sugar-like body, which was known to occur in rubber latex but the presence of which in prepared rubber was unexpected, on account of its great solubility in water.

Experiments were described on the artificial conversion of rubber into a resin as a result of the absorption of oxygen from the air under the influence of catalysts. One mode of carrying out this conversion which Dr. Whitby has worked out may lead to the production of lacs or varnishes from rubber. The study of this conversion is also of importance because of its relation to the "perishing" of rubber goods.

Manufacture, Properties and Employment of Heat-Intercepting Glasses

Prof. Gelert Alleman in introducing the subject of heat-intercepting glasses described how silver nitrate when exposed to the action of light passing through ordinary glass is discolored, while if placed in a container of special glass no change is noticed. Similarly smoked bulb thermometers exposed under the same conditions will record different temperatures, that in which the ordinary glass is used showing a higher temperature than that protected by the special glass.

Sir William Crookes was the first to investigate glass with the object of securing a spectacle glass which would protect the eyes from heat and ultra-violet rays and reduce glare. He concluded that cerium salts were most effective in this way and black mica added to the melt produced a glass which almost completely obstructed the invisible heat rays.

About five years ago Mr. Sherman, then chief chemist of the Pennsylvania Wire Glass Co., conducted 227 experiments using various mixtures and confirmed Crookes' work and produced a more brilliant glass by a slight manipulation of the furnace temperature. This material is now a commercial product known as actinic or heat-intercepting glass, manufactured into plate polish, plate wire, plate proof wire, aqueduct wire, ribbed wire and corrugated wire glass.

These different types were described, emphasis being laid upon the importance of annealing. An instance was given of the resistance of the corrugated wire glass to shock. A 2¼-in. steel smokestack 24 in. in diameter and 25 ft. in length fell in a severe windstorm on the corrugated wire glass roof of a large boiler house. While two plates were destroyed and the remainder of the glass cracked or bent, it was not shattered and did not leak, although the steel beams on which the glass rested were bent out of line about 3 in.

Tables were shown covering tests made on houses erected of the various types of heat-intercepting glass showing the marked difference between the temperatures inside and outside the house and also showing the high percentage of light transmitted, the lowest being 72 per cent.

Preparation of Synthetic Organic Chemicals

In dealing with "The Preparation of Synthetic Organic Chemicals at Rochester," Dr. C. E. K. Mees first took up the status of chemistry of the present day as compared to that of ten years ago, emphasizing the need of research and its co-operation with industry.

Before 1914 the supply of synthetic organic chemicals was entirely in the hands of one or two firms in Ger-

many. With the outbreak of hostilities, this supply was cut off and the effect was soon felt. Many researches had to be abandoned. Prof. C. G. Derick of University of Illinois met the situation by inviting the most promising students to work during vacation on those organic compounds most needed. This was a unique step, the reactions being conducted on a scale unusual in research work. As it was very evident that the supply of organic chemicals was inadequate, the Eastman Kodak Co. in 1918 decided to enter the field, having no prospect of immediate profit. The work undertaken was: 1. Synthesis of compounds which are not prepared technically but are required for laboratory purposes. 2. Purification of technical materials got from chemical manufacturers. 3. Distribution of such technical chemicals in form in which purchased.

Raw materials were obtained largely from dye, dye intermediate, perfumery, explosives and pharmaceutical chemical manufacturers, also from individuals in university and other laboratories. The chemicals produced are classified under: 1. The Eastman chemicals (highest possible purity). 2. The practical chemicals (purity sufficient for synthesis). 3. Technical products (as from large scale manufacturers).

Briquetting of Lignites

Leslie R. Thomson described the work that has been done on lignite briquetting by the Lignite Utilization Board of Canada since its inception in October, 1918, and illustrated his paper with a number of diagrams, drawings and tables of results.

The Provinces of Manitoba and Saskatchewan are largely dependent upon American anthracite coal for domestic heating purposes and during the years preceding the war about 500,000 tons was annually imported. The price of this imported coal naturally increased as one went westward owing to the higher freight charges. It continued to find a market until the price went so high that the consumers were willing to put up with the disadvantages of the much cheaper Alberta coals. This "peak" line runs in a general north and south direction through the eastern part of Saskatchewan. Directly beneath this area, however, there are very large deposits of rather low-grade lignites, which, after carbonizing and briquetting, are capable of being converted into a fuel of high calorific value.

The Lignite Utilization Board was therefore established by the Canadian Honorary Advisory Council for Scientific Research to attack this problem and if possible to demonstrate the feasibility of producing a satisfactory domestic fuel from these lignites by the method of carbonizing and briquetting. After preliminary experiments at the Fuel Testing Laboratory of the Department of Mines, Ottawa, into various phases of the methods to be adopted, a plant was designed and erected at Bienfait, Sask., to have a capacity of 100 tons of briquets per day and has just been put into operation.

At this plant the lignite is first carbonized by heating to a low temperature in order to drive off the more volatile portion and the residue is mixed with a coal-tar pitch binder under suitable control, and after grinding together the mixture is pressed into briquets in a roll press. The briquets weigh about 2 oz. each and are egg shaped. The summarized results are:

1. It has been possible to make a first-quality commercial fuel briquet from carbonized lignite using any one of such binders as coal-tar pitch, petroleum pitch, hardwood tar pitch, sulphite liquor pitch, or by using combinations of them.

2. The quantity of binder required is much in excess of that necessary to make a correspondingly good briquet from anthracite fines.

3. A waterproof briquet of carbonized lignite cannot be made using sulphite pitch as a single binder unless the briquets are heat-treated subsequently.

4. The choice of binder does not rest so much with the technical difficulties involved in its use, but with the economic supply of that particular binder. In other words, the Lignite Board has succeeded in making good briquets from many binders.

The Recovery of Peat by Air-Drying

Dr. Ernest V. Moore in his paper on "The Recovery of Peat by Air-Drying" described a practical method of turning raw peat into a product of economic value. Peat is a combustible substance produced by slow decomposition of vegetable matter and occurs saturated with water in peat bogs typical of the Northern Hemisphere. To transform raw peat into combustible material it is necessary to reduce its water content of 90 or 95 per cent to about 30 per cent. Drying is effected best by evaporation in the open air.

Great difficulties of collecting peat are overcome by gathering it with a combined excavator and macerator which is supported on caterpillar-tread carrying elements—a device more useful than rails on a soft peat bog. The raw peat is carried by a belt conveyor from the macerator to adjoining higher land, where it is spread from 3 to 6 in. thick on the ground, cut into blocks and allowed to dry in the sun. The blocks are turned to insure uniform drying, and in from 30 to 40 days the moisture content drops to 30 per cent and the peat is ready for domestic use or even for some industrial uses—especially drying operations where a very clean fuel is necessary. Though air-dried peat has twice the volume of an equal weight of coal, Dr. Moore declared that the average householder would gain by replacing 20 per cent of his anthracite pound for pound with air-dried peat.

The Activation of Carbon

Prof. E. G. R. Ardagh in presenting his paper on "Activated Carbon" pointed out that of all the so-called common elements carbon appears to possess greater possibilities both to the investigator in pure science and the researcher in the industrial field.

The paper dealt with amorphous carbon, more especially with its power of absorbing colors from liquids and gases, a phenomenon generally known as adsorption. The progress that has been made in this field is shown to be very considerable particularly during the last ten years. Carbons are today being manufactured that are replacing to some extent fullers earth as a decolorizing and dechlorizing substance in certain industries, and it is not too much to hope that in the not distant future a carbon sufficiently active as a color remover may be produced at a price to supplant bone black in the manufacture of sugar and syrups.

The work of Dr. N. K. Chaney of the U. S. Chemical Warfare Service has thrown an entirely new light on the causes of activity in carbon. Basing its work on Chaney's hypothesis the Chemical Warfare Service of the U. S. was able to produce absorbents for gas mask canisters that were greatly superior to any the enemy were able to make.

Other Entertainment

One of the most interesting functions was that held on the third day of the meeting in Montreal, when an inspiring address was delivered after luncheon by Jacques Bureau, M.P. for Three Rivers, in which district the Shawinigan industries are situated. In pleading for the elimination of waste Mr. Bureau paid tribute to the work of scientists in connection with the pulp and paper industries, which in the St. Maurice Valley alone represented an investment of about $150,000,000.

"Ancient Order of Trismegistians" Organized

On the evening of Aug. 31 the overseas delegates entertained their hosts to a dinner of the "Ancient Order of Trismegistians," which had been formed for the occasion and the rites in connection with which were of a novel and amusing description. The ritual included the presentation to Dr. R. F. Ruttan of a "piece of plate" and of an "illuminated address." The former consisted of a fragment of a dinner plate in a handsome case and the latter was a card mounted in a silver frame illuminated for the occasion by an electric torch and bearing the inscription "Dr. R. F. Ruttan, Society of Comical Industry, Sensible House, Fairand Square, London." As is customary in the Ancient Order, Dr. Ruttan had to give a song when returning the thanks, and these and other entertaining items contributed to a happy and thoroughly enjoyable evening, punctuated by Sir William Pope's usual dry humor.

Visits to Other Sections and Works

Prior to the annual meeting proper the overseas delegates spent some days in Montreal visiting works, such as the St. Lawrence Sugar Refinery, the Gillette Razor Co., the Laval University of Montreal, and similar institutions. They were also the guests of the Harbor Commissioners, who took them for a trip around the harbor in a steam yacht. Frederick W. Cowie, the chief engineer, and Mr. Ross were the hosts at the luncheon given on board, which proved so enjoyable that when it was over the visitors found that they had returned to the spot from which the boat had started, so that the latter was really the one that did the sightseeing. Several of the visitors were subsequently solaced by a personally conducted tour on land over the grain elevators, warehouses, cold storage buildings and other developments now in process of construction at Montreal Harbor.

On leaving Montreal a whole day was spent at the Laurentide Company's Paper Mills at Grand Mère and in going over the extensive electrochemical industries at Shawinigan Falls, where a section of the Society of Chemical Industry has just been established. Following this, entertainments on a lavish scale were successively provided by the Ottawa and Toronto sections, the visitors being continuously cared for during this period on special sleeping cars. A rough crossing over Lake Ontario preceded their arrival at Niagara Falls, where on Sept. 5 they were officially received by an American delegation including General Kincaid, representing the Governor of New York State; Dr. W. H. Nichols, A. H. Hooker, and the presidents of the American Chemical Society, the American Institute of Chemical Engineers and the American Electrochemical Society. Dinner was served at the Buffalo University Club and in the happiest of surroundings the visitors greatly appreciated their first introduction to American banquet procedure.

The visit to Syracuse, where the plant of the Solvay Process Co. was visited, proved of great interest and the visitors were informed that an inspection by members of learned societies and by industrial chemists was without precedent at these works. In view of the subsequent announcement made by Dr. Nichols that the problem of manufacturing synthetic ammonia had now been completely solved at these works, it is unfortunate that it was not possible to inspect the nitrogen products section. But instead a few of the visitors were able to spend some time in the works of the Franklin Motor Car Co. and to take with them some idea of modern American methods in this important industry.

The general impression among the visitors is that the convention will do an immense amount of good to the status and influence of the Society of Chemical Industry. It has not only been a liberal education to its officials, but all members of the party have learned that it is only by a personal visit to the American Continent that the essential differences in outlook between English and American chemists can be harmonized, such divergences being in the relative size of organization. Thus it is doubtful whether any member of the party had previously realized that Canada's fundamental difficulty and source of her partial dependence upon the United States is the location of her coal fields at the eastern and western extremities, while the intervening districts must largely be supplied with fuel from Pennsylvania, etc., until such time as peat or other fuel developments can partly relieve the situation.

Dr. Ruttan Wise Selection as President

On the personal side there is no doubt that Dr. Ruttan was an eminently wise and suitable selection for the office of president as well as an intensely popular one. He can be relied upon not only to represent the academic but also the industrial and chemical engineering interests of the many different countries over which the society wields its influence. Mention should also be made of the new vice-president, C. S. Garland, managing director of Lighting Trades, Ltd., a constituent of Nobel Industries. Like so many really busy men, Mr. Garland finds time for the development, organization and welfare not only of the chemical industry but of the younger generation of chemists, while for the society his business capacity has been a great asset. Mr. Clayton, Mr. Heap and Dr. Atack represent the manufacturing interests, from which a far larger number of representatives should undoubtedly have attended. Mr. Alliott represents the chemical plant interest and Dr. Jordan is chemical engineer to the British Xylonite Co. Consulting chemical engineers are represented by Capt. C. J. Goodwin of London, whose work in this country and abroad is well known and who is also the official delegate of the Chemical Engineering Group and of the Chemical Industry Club.

New Spirit of Co-operation and Progress

In the past the Society of Chemical Industry has often been held to be an ultraconservative institution, yielding slowly to public opinion, progress and publicity. There are many indications that a new spirit is abroad, and although the number of visitors is small, every one of them will return as a missionary preaching not only the broad principles of progress suitably modified to suit local conditions, but also that spirit of co-operation and personal friendship which the present memorable trip has done so much to foster.

Further Observations on p_H in Natural Waters

Factors Affecting the Hydrogen-Ion Concentration of Natural Waters— Influence of Hydrogen-Ion Concentration on the Removal of Bacteria and Suspended Matter by Filtration, and on the Processes of Disinfection With Chlorine or Its Derivatives

BY ABEL WOLMAN* AND FRANK HANNAN†

IN AN earlier publication[1] by the present authors the theoretical aspects of the influence of p_H on the precipitation of aluminum salts in water were discussed at some length. Since that time it has been possible to accumulate a considerable number of p_H readings on a natural water, the consideration of which should be of interest. The field of knowledge of H-ion concentration is being so diligently explored in all directions, particularly in this country, that it would be a gigantic if not an impossible task to enumerate pertinent references in current literature. It would therefore certainly be invidious to make any selection. However, to any who follow even in a general manner the trend of progress in this field such names as Loeb, Clark and Lubs, Michaelis and Bechhold will offer ample opportunity for intensive study.

In the present discussion it is the intention of the authors to sketch briefly the preliminary conclusions resulting from p_H observations during the past eleven months in a natural water. At the same time the opportunity will be taken to suggest the particular and general significance of such p_H readings as now appear probable.

FACTORS CONTROLLING p_H IN WATER

At this point it may be proper to recall the primary factors which govern the H-ion concentration of waters. These have been set forth in considerable detail and with admirable clearness by Johnston[2] and Stieglitz[3] in the papers noted in the bibliography below. Their conclusions are summarized in strikingly clear form by Bjerrum and Gjaldbaek[4] in the expression $[H^+] = K\sqrt{P} \times [Ca^{++}]$. This formula holds for all waters which are at one and the same time in equilibrium both with calcite and with the partial pressure P of CO_2 in the atmosphere. Collins[5] has shown that this is the case approximately with the majority of our natural waters. In those waters which are not yet in equilibrium the general trend is in that direction. In the remarks to follow we shall confine ourselves to the consideration of those waters which approximate equilibrium with calcite and atmosphere.

The value of K varies only with the temperature. At any given temperature, therefore, the equilibrium value of $[H^+]$ varies directly as the square root of the concentration of the calcium-ion and as the square root of the partial pressure of CO_2 in the atmosphere. Under particular conditions, it appears that, to all intents and purposes, K is a constant. The reactions, however, which bring about and constitute equilibrium are numerous and are subject to minor local disturbances and some of them may require many hours for completion. The natural result of such a condition is that in practice the p_H value of a water as a rule is found to be oscillating gently in the neighborhood of the equilibrium point, much as a tree is swayed by the wind or as a boat moored in a tideway. When subjected to violent alteration—as for example by filtration—it returns slowly toward the equilibrium. In a similar manner biological concentration above a certain critical limit is able to effect a semi-permanent change in $[H^+]$ which may last even for months. Eventually, however, if isolated, the biological concentration falls and the p_H value returns to the equilibrium.

In the foregoing statements no mention has been made of the effect of temperature, which is, under natural conditions, considerable. The constant K is built up from five other constants. It has a marked temperature coefficient; becoming greater as the temperature falls. Bjerrum and Gjaldbaek[4] give the value of —5.2 for log K at 18 deg. C. It would be decidedly helpful if determinations of the value of K were available through the range from 0 deg. to 100 deg. C., since the considerable changes which the value of K undergoes by reason of temperature variation would shed much light on many natural processes which are now relatively inexplicable.

ACTUAL OBSERVATIONS OF p_H VALUES

p_H and Temperature. Beginning in August, 1920, daily determinations of the reaction of Lake Ontario water have been carried out for a period of eleven months. During this time approximately 4,400 tests were made at various stations and at different intervals of time. In the absence of electrometric apparatus, the following procedure was adopted: To 100 c.c. of a sample of water there was added 0.5 c.c. of a 0.5 per cent solution of phenolphthalein. The reactions are reported according to the following arbitrary scale of numbers, the p_H equivalents of which it is hoped to determine later.

Reaction No.	Description	P_H Equivalent (Provisional Estimate)
0	Indistinguishable from water	7.8
5	Indistinguishable without comparison tube	8.0
10	Faintly alkaline	8.2
15	Alkaline	8.4
20	Strongly alkaline	8.6
25	Very strongly alkaline	8.8
30	Intensely alkaline	9.0

The first determinations in each instance were made upon a fresh sample of water, and subsequent readings were taken upon standing in the laboratory for 24, 48, 72 and, at times, 96 hours. The importance of these series of readings will be discussed at greater length later.

In view of the manner in which the above determinations have been obtained (the only method available under the local conditions), the authors expressly disclaim any pretension to "absolute-value" accuracy. It is certainly justifiable, however, to make strong claim

*Maryland State Department of Health.
†Toronto Water Filtration Plant.

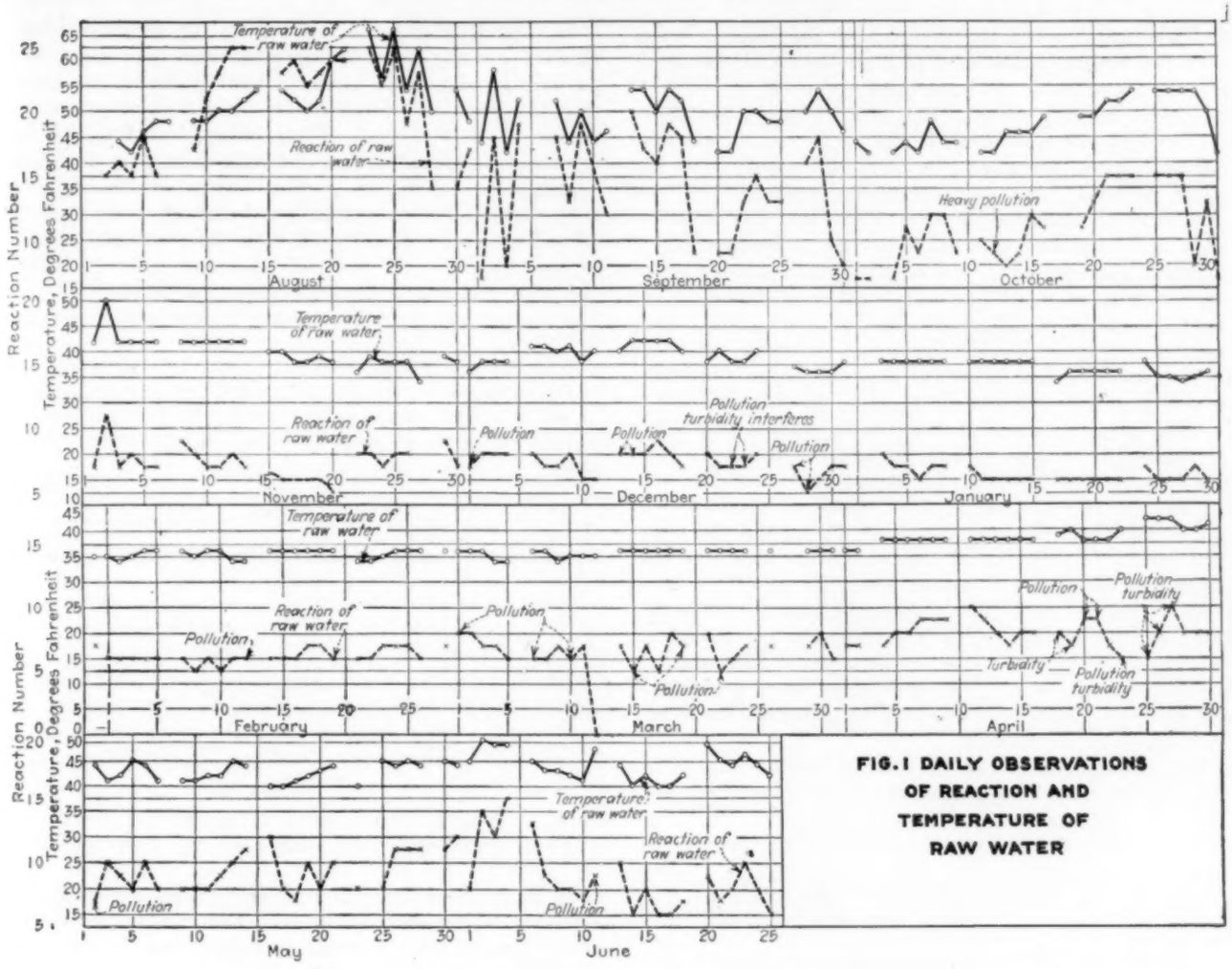

FIG. 1 DAILY OBSERVATIONS OF REACTION AND TEMPERATURE OF RAW WATER

to "relative-value" accuracy so far as the conditions of the experiments go and because of the care taken in carrying out the tests. In each instance the test tube used was rinsed, brushed and soaked for some time with fairly strong HCl, to prevent after-effects due to solution of glass with resultant increase in alkalinity of the liquid tested. After soaking, the tube is again well-rinsed, brushed twice with complete rinsing following each brush, and then rinsed three times with distilled water. This procedure is followed by three washes with the water to be tested, after which the tube is filled to the mark.

In Fig. 1 there have been plotted the daily readings, for eleven months, of the temperature and the p_H of the waters at a certain intake on Lake Ontario, which supplies a mechanical filtration plant. A similar series of readings at a neighboring intake, furnishing a slow-sand plant, are not plotted, since they differ only slightly from those used. It is at once apparent from the data in Fig. 1 that the reaction of the raw water is continually fluctuating in accordance with the water temperature. The striking fact appears that the p_H values show marked seasonal as well as daily changes, which in turn are influenced in a secondary manner by biological contamination. It is important to call attention to the fact that in most instances these delicate fluctuations in reaction are not reflected in the usual titration measurements for alkalinity.

p_H and Filtration. In order to study the changes which such processes as alum addition and rapid filtration effect in reaction of water, daily determinations were carried out upon the effluents of a mechanical filtration plant from August, 1920, to June 26, 1921. Only two months' observations are shown on Fig. 2, since these are characteristic of the summer and winter conditions as indicated by all the tests. It is apparent that the combination of alum treatment and filtration causes striking changes in p_H conditions. The fact that filtration alone is responsible for major effects is further illustrated by data shown in Fig. 3, where a comparison is presented between reactions of slow-sand as against those of rapid-sand filter effluents. It is well to bear in mind that such upheavals as filtration alone may occasion as profound changes in the equilibria of waters as do the more familiar chemical processes, as alum treatment.

It is true, of course, that such changes in reaction as have been indicated above are only semi-permanent in character, but they are of sufficiently long duration to make their effect of prime importance. Although adjustments are continually in process, the periods of time necesssary to reach complete equilibrium, after such cataclysmic disturbances as filtration, may stretch into three or four days. These phenomena of internal adjustment in reaction are well brought out in another series of selected readings in Fig. 4, which represent only a few of hundreds of similar tests during summer and winter conditions.

The significance of the data shown on Fig. 2 will be even more striking when it is noted that the most effective filtration, from the standpoint of removal of bacteria and suspended matter, is accomplished usually

at those times when the reaction of the filtered water is in the neighborhood of 0 to 2 on the particular scale used in these tests. It is certainly of great importance to emphasize this observation, since therein lies probably one of the least known and most crucial regulating factors of filtration—namely, the reaction of the liquid filtered. We call attention especially to this particular phenomenon, in view of the fact that hitherto little attention has been paid in the interpretation of filtration experiment to the reaction of the water under study. The standardization of rates of filtration, of depths of sand beds and of sizes of sand grains have been determined in most instances without reference to the reactions and electrical signs of either the water or the materials suspended therein. In this connection it need only be recalled that many substances when suspended in water become negatively charged, with the intensity of the charge increasing when the concentration of the hydroxyl-ion becomes greater. In particular, clay particles and bacteria are usually negative, while it is believed that alumina used for mechanical filtration is negative when the p_H of the solution is greater than 7.5 (Sörensen's scale). Naturally the negative charges of such substances are influenced greatly when the H-ion concentration is increased or lowered. Because of these influences, it is possible to see why reaction should control, to a degree, both rate and efficiency of filtration.

The importance of the reaction of the medium being filtered has been amply demonstrated in another field

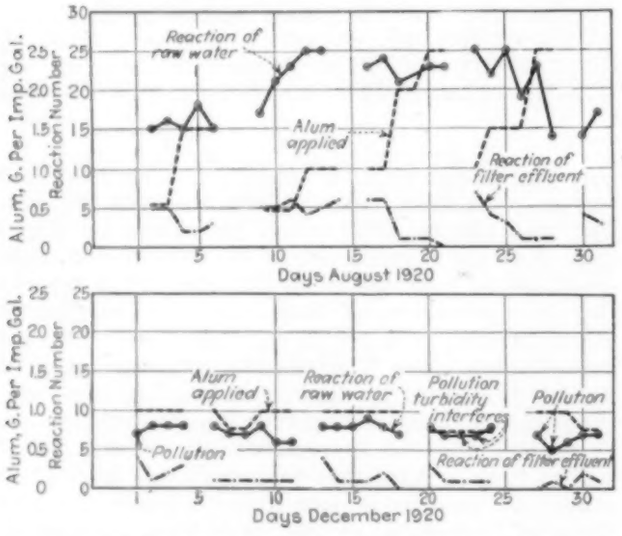

FIG. 2. EFFECT OF RAPID SAND FILTRATION AND ALUM TREATMENT ON REACTION OF RAW WATER

of scientific investigation by Holderer[8] in a masterly thesis, which should be more familiar to waterworks men. Holderer, in his experiments on the filtration of enzymes, obtains the following characteristic results:

	Reaction of Liquid	Per Cent Removal of Enzymes by Filtration
a.	Neutral to phenolphthalein	0
b.	Neutral to methyl orange	96
c.	Intermediate reaction	75

It is clear from the data shown above, which are typical of those found in the filtration of numerous other finely suspended or colloidal materials, that the reaction of the medium being filtered is fundamentally the controlling mechanism of the success or failure of filtration.

In fact, Holderer concludes from his series of observations on filtration of finely divided particles, comparable in size with bacteria usually found in water, that the reaction of the liquid filtered is of prime importance. His process of reasoning, based on his experimental results carried out with care, may be briefly summarized as follows: The volume of granules is very variable and is especially a function of the reaction of the medium. One ought, therefore, to take account of this reaction, all the more because upon it depend the sign and the size of the electrical charge. Perrin has shown in effect that every membrane in contact

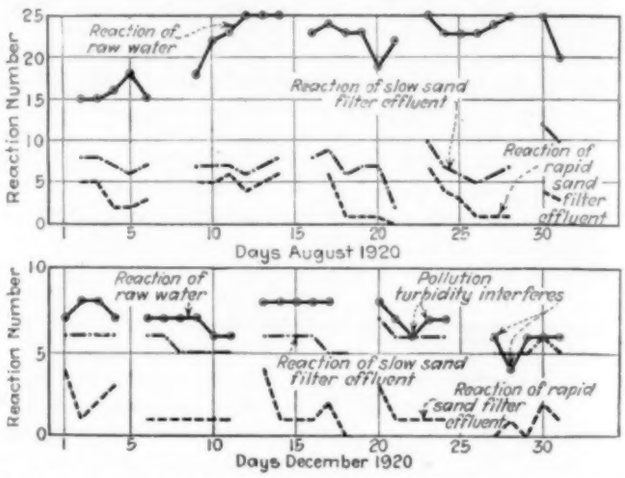
Reaction Number
Reaction of raw water
Reaction of slow sand filter effluent
Reaction of rapid sand filter effluent
Days August 1920
Reaction of raw water
Pollution turbidity interferes
Reaction of slow sand filter effluent
Reaction of rapid sand filter effluent
Days December 1920

FIG. 3. COMPARATIVE EFFECTS OF RAPID AND SLOW SAND FILTRATION ON REACTION OF RAW WATER

with an alkaline solution is charged with negative electricity. If the solution is acid, the membrane is positive. Quincke further demonstrates that if we cause alkaline water to pass through a capillary tube, or a filter of sand or of gelatine, we obtain the positive charge of the water toward the outlet, while at the entrance the negative electricity has accumulated. These two charges, positive and negative at outlet and inlet, constitute an electromotive force of filtration opposing the movement of liquid.

Since we have already seen that the size of the particles is primarily a function of the reaction of the medium, there is nothing astonishing therefore that, from the point of view of speed of filtration, it is again the reaction of the liquid which is most important. This conception is further supported by evidence accumulated to show that the adsorption effects in filtration are also dependent upon the reaction of the medium and of the polyvalent coagulating ions.

The Nature of Filtration

One cannot refrain, on account of the excellence of the reasoning, from quoting further from the thesis by Holderer, on the question of the nature of filtration:

"By what mechanism is the retention of enzymes brought about? Is it a sort of entrapping or a phenomenon of attraction? The study of the influence of coagulating and dispersing agents, such as albumin, has made it possible for me to conclude that it is particularly a phenomenon of adsorption—that is to say, by attraction primarily. Yet for enzymes poorly dissolved or which are in a state of partial coagulation, it is evident that we have a phenomenon of entrapping.

"One cannot attribute the retention of sucrase on the filter to an impoverishment of salts, for the addi-

tion to the filtrate of all the salts of the original solution produces no activation.

"Sucrase is retained therefore by adsorption and not by entrapping. It is the most frequent case. Enzymes act like bacteria. Duclaux in fact has already noted the force of adhesion which retains bacteria. 'From the standpoint of the average dimension of spores,' he said, 'the pores of the most porous substance are as tunnels toward wagons.'" Holderer further points out that "the spores of *Aspergillus niger* are retained by simple filtration through paper in a reaction neutral to methyl-orange, while at neutrality to phenolphthalein they pass through the filter paper. This remark suggests the thought of a work similar to this upon the question of the filterability of bacteria at various reactions."

Unfortunately the authors have been unable to find any further research along the lines suggested above, but it certainly appears from the data which Holderer has set forth, from the recent work on the filter-pressing of sewage sludge by Wilson, Copeland and Heisig[7] and from the observations reported in this paper by the present authors, that important results would probably appear if new studies were carried out upon the entire problem of the mechanism of water filtration from the standpoint referred to above. It is not too optimistic to suggest that in such studies it may even be found that a considerable revision of our present concepts of the importance of definite gradation of size of sand and of definite rates of filtration may be necessary.

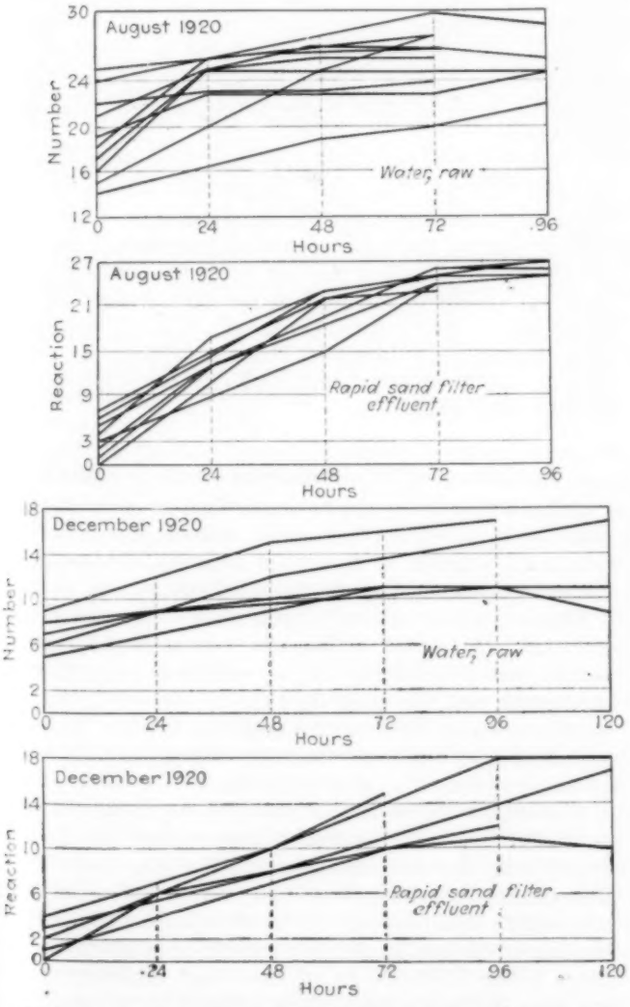

FIG. 4. TREND OF REACTION OF WATERS TOWARD EQUILIBRIUM

In a similar manner, as has already been pointed out by the writer,[1] much fruitful research is possible in the field of precipitation and sedimentation of suspended particles, where the forces of electrical repulsion and of molecular attraction come into play. The solution of the problems arising in this field do not differ in method from those which appear in filtration. For the sand filter itself has the character of a charged membrane, the variations in whose charge may tend materially to promote or to retard the rate and efficiency of filtration.

p_H and Chlorination. Some reference should be made, if only briefly, to the possible significance of reaction of water in processes of disinfection with chlorine or its derivatives. Insufficient material is available upon which to draw any conclusions at this time. It is known, however, that the efficiency of such processes varies from season to season and even from hour to hour, but only the elementary causes of such variations are understood. For this reason, the recent studies reported upon by Rideal and Evans[8] are of special importance. They recognize that hypochlorites, for instance, are usually applied to waters "irrespective of whether the fluid be acid, neutral or alkaline." Their preliminary conclusions are peculiarly interesting in connection with the figures reported upon in this paper. Several excerpts from the work of Rideal and Evans[8] are, therefore, noted here for emphasis:

Rideal and Evans' Conclusions

"We find that two waters, one an 'acid' water containing free carbon dioxide and the other an 'alkaline' water, such as occurs in the London basin, dosed with hypochlorite so that they contain the same amount of 'available chlorine' (as measured by the ordinary iodometric method with titration in presence of acetic acid), give quite different results when allowed to flow through the electrical instrument. The acid water gives a large deflection, indicating high oxidizing activity; the alkaline water gives a much smaller deflection, indicating that the oxidation potential has been depressed.

"Since the germicidal properties . . . are in part due to its oxidizing power, it seems likely that these also will be affected by the hydrogen-ion concentration of the water. It would be worth while, therefore, to consider whether, if alkaline waters have to be treated with this class of sterilizer, they should not at the same time be rendered just acid to litmus, or at least neutral, by the addition of niter cake, aluminum sulphate or even by treatment with carbon dioxide gas."

Temperature, Reaction and Filtration

If the data presented above are valid, what effect may we be led to expect in such processes as sand filtration from season to season? Theory would certainly indicate that it should be more difficult to get good results from our filters in the warmer months, when the p_H is higher. In actual practice, this is frequently the case, but it is sometimes ascribed to "colloidal difficulties." Its obvious remedy should be an increased dose of alum, which will result in a reduction of p_H to the point of improved operation. In calculating such dosages of chemical, we should not lose sight of the fact that the initial CO_2 content of the water, as well as that lost to the atmosphere in such processes as mixing, are controlling factors no less than the alumi-

num sulphate used. In other words, the floc-forming power of alum has frequently overshadowed its CO_2 productivity. The latter may be the more important regulating mechanism of precipitation and filtration.

Evidence confirmatory of the hypothesis that efficiency of filtration and coagulation processes vary inversely with p_H is given by the data presented in an excellent paper by Jordan.[9] The latter clearly points out that filtration, taken as a whole, falls off in effectiveness as the temperature rises, a phenomenon which Jordan associates with increased biological activity. But biological activity is actuated by such mechanisms as osmotic pressure across the membranes, which pressures Loeb[10] has shown vary with potential difference and with p_H. Since temperature, p_H and biological activity are correlated phenomena, p_H again is the significant explanatory index to seasonal variation in filter efficiency.

Correlated Phenomena

The opportunity should be taken at this point to indicate the fact that the temperature-reaction phenomena discussed above may have important applications to problems not specifically mentioned in this paper. The principles outlined herein should have far-reaching effects in clarifying some of the concepts in the fields of botany, zoology and physiology. It is not, of course, within the scope of this paper to go into the details of the problems in these fields, but a sufficient number of pertinent facts have appeared in our researches to indicate the importance of the data herein presented to the other branches of science. The workers with soils, plants and animals will no doubt be able to adapt some of the findings to their own problems.

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Decline of the Sicilian Sulphur Industry

Until recent years Sicily was the most important factor in the world's supply of sulphur, but it has now been displaced by the American sulphur industry, which has developed a very large production owing to the easy extraction of this mineral from the Louisiana and Texas mines, declares Consul Louis G. Dreyfus, Jr., of Palermo, Italy, in *Commerce Reports*.

The production of sulphur in Sicily rose from 120,000 tons in 1860 to 538,534 tons in 1905. In 1919 production decreased to 181,374 tons, but rose to 219,844 tons in 1920. On the other hand, the production of American sulphur increased from 893 long tons in 1883 to 25,000 tons in 1903 and 491,080 tons in 1913, and reached 1,255,249 long tons (preliminary figures of the United States Geological Survey) in 1920. Besides these two countries, Japan, with an output of about 50,000 tons, is the only other important source of sulphur. Small quantities are produced in Spain and Austria.

During the war sulphur, which was required for the production of ammunition, was in great demand, but owing to the lack of tonnage the shipment of American sulphur to Europe was interrupted. The Italian Government commandeered the sulphur trade, authorizing exportation only with special permits. Now that freights are again normal, American sulphur exporters are everywhere underbidding the Sicilian product. In fact, the American quotation c.i.f. Hamburg, delivery weight, was at the beginning of June, 1921, 1,320 marks, while Sicily was quoted about 3,000 marks. The Sicilian product has been completely displaced in the important Scandinavian markets and is facing keen competition in Belgium, England, the Netherlands, France, Germany and Africa.

It is said that American sulphur is superior to the Sicilian for the chemical industries. However, the latter is preferred locally for the vineyards, where it is used to protect the foliage against parasites, because it is said the flour-milled product from the United States does not adhere to the leaf to the same extent as does the Sicilian. Partly for this reason and partly because of their geographic location France, Spain, Portugal, Algeria and Greece still look to Sicily for sulphur to be used in their vineyards.

Statistics of the Canadian Soap Industry

Canada spends in the neighborhood of $14,000,000 a year on soap, according to a recent report of the Dominion Bureau of Statistics relating to the manufacture of soap in Canada during 1918.

Thirteen of the twenty-eight plants engaged in this industry are located in Ontario. During the year reported over 100,000,000 lb. of soap was manufactured in Canada and the quantity sold by the producers was worth over $13,000,000. In addition to this there was imported into Canada something over $1,000,000 worth of soap produced in other countries.

The report states that exports of soaps amounted to only slightly over $100,000. There is thus an apparent opportunity for the expansion of the soap industry in the country to take care of the million dollar importation which now exists. It is stated that the bulk of the imported soap is of the common or laundry variety, there being 5,000,000 lb. of this soap imported during the year under review. Over 800,000 lb. of soap powders was also brought in. The quantity of toilet soap imported is not stated, but the value was $592,000.

Melting Fine and Sterling Silver by Electricity

A Description of the Operating Conditions for Melting Fine and Sterling Silver in an Electric Furnace—Arrangement of a Silver Melting Outfit—Comparison of the Qualities of Electric and Crucible Silver

BY H. A. DE FRIES
Consulting Engineer

THE writer lately had the opportunity to conduct the melting of fine and sterling silver on a large scale in an electric furnace. In the following will be enumerated the principal points which have to be taken into consideration for such melting:

It is generally surmised that a pouring temperature of 1,900 to 2,000 deg. F. (about 1,040 to 1,095 deg. C.) is sufficient. This degree of heat will suffice if the silver is cast into bars for remelting. If one, however, endeavors to pour silver at this temperature into rolling stock or castings, the resulting metal would be so brittle as to be entirely worthless for subsequent working. The proper temperature at which such silver should be cast is 2,360 to 2,380 deg. F. (about 1,295 to 1,305 deg. C.) if cast into horizontal or nearly horizontal molds, or 2,200 deg. F. (about 1,205 deg. C.) when vertical molds are used. Utmost care has to be exercised in handling the molten metal between furnace and molds, and any chilling should be prevented as much as possible, as a difference of only 200 deg. F. will produce crystallization with attending brittleness. During melting the silver should remain quiet and the bath should not be disturbed by stirring or rocking.

AFFINITY OF SILVER FOR GASES

It seems that during melting a protective cover is formed, which protects the silver from gases. It is well known that silver has a great affinity for gases, especially oxygen, and if this cover is disturbed by stirring, etc., unprotected silver is brought into contact with the furnace gases and entering air, which will be absorbed at once.

Notwithstanding that fine silver is supposed to liberate most occluded gases by spitting on cooling, enough will remain, even though in very small quantities, to have a decided influence on the structure and ductility of the resulting metal.

How susceptible silver is to gases is best illustrated by melting it in an oil-fired crucible. In such operation a marked difference in quality of the metal will be apparent when using oils of varying analyses; even a change in the barometric pressure of the air used for combustion will be immediately noticeable.

As the atmosphere in an electric furnace is independent of outside conditions and can be changed at will, an absolute oxygen control is made possible, and this is of the greatest advantage. In practice it was found that an almost neutral atmosphere, tending toward being slightly reducing, is most suitable. This atmosphere can be easily obtained in an arc furnace and the carbon supplied by the electrodes is in most cases sufficient.

If a more reducing atmosphere is required, some charcoal may be added after the silver is molten. Powdered coal in quantities not exceeding 1 lb. per 5,000 oz. of silver will be found most effective. It is evident that the furnace itself should be airtight and if an arc furnace is used stuffing boxes should be provided at the electrode ports. Pouring the charge through the furnace door will not do, if the door has to be open during pouring. It is much better to pour the silver through a separate taphole, which can be lined and kept closed by a plug made from an electrode stump.

The travel of the metal from spout to mold should be as short as possible. With proper arrangements the writer has experienced no trouble from skin forming during pouring. If an intermediate receptacle is used between spout and mold, it should be thoroughly preheated. Any metal left in this receptacle should be poured out and no new metal should be poured on top of it. The molds should be smoked and heated to about 400 deg. F. (about 205 deg. C.).

In making rolling silver, the time-honored method of having a piece of wrought iron or mild steel in the bottom of the hearth should be adhered to, as it will be a great help in keeping a low oxygen equilibrium in the metal, and at the same time this piece of iron will act as a stabilizer for the heat of the silver.

In starting up a new furnace the operator may not be able to judge the right pouring temperature from the appearance of the metal, and until he becomes familiar with it he should resort to the well-known pouring and annealing tests.

ELIMINATION OF IMPURITIES

The impurities in silver, especially if old metal and scrap are remelted, will be mostly in such small quantities as to be but a fraction of a per cent; in most cases the impurities are due to small quantities of german silver. Two methods can be used of partly eliminating the impurities in the furnace—i.e., by either slagging them off or by removal through cupellation. The second method is the one most commonly employed in arc furnaces. When using this method the electrodes are to be brought almost in contact with the bare bath and the furnace run slightly oxidizing for a short period.

FURNACES USED

After having thus discussed the principal necessities for the electric melting of silver, it is apparent that only two types of furnaces can come into consideration —i.e., the indirect arc furnace of the stationary type and a certain type of induction furnace, such as the Ajax-Northrup. The indirect arc furnace seems to possess greater adaptability to this work than the Ajax-Northrup, and this is especially true in regard to capacity.

The furnace the writer used during his silver runs was of the Rennerfelt type, especially constructed for the purpose and of 10,000-oz. capacity. The average charge was 4,000 oz. and the power consumption averaged 330 kw.-hr. per ton of silver. I understand that silver was melted in the Ajax-Northrup furnace with about 320 kw.-hr., so that it checks closely with results obtained in the Rennerfelt. Preheating is included in the figure of 330 kw.-hr.

The lining of the indirect arc furnace should be either of silica brick or firebrick, with a hearth of gannister or carborundum. This hearth material should be wetted down with silicate of soda, tightly rammed in and thoroughly sintered with the arc. The life of such a lining will be almost indefinite.

The determination of the metal loss was not quite conclusive, but on the average it amounted to about 2 oz. per 1,000 oz. melted. Some silver will always be absorbed in any newly lined furnace, and after the furnace has been in use a little longer I feel confident that silver can be melted in electric furnaces with a total loss not exceeding 5 oz. per 10,000 oz. melted. The electrode consumption will average about 5 lb. per ton.

The furnace will produce about 60,000 oz. of silver per eight hours and the cost of melting and casting 1,000 oz. into rolling ingots will be as follows:

Loss, 0.5 oz. per 1,000 oz.	$0.25
Power, 12 kw.-hr. at 2c.	.24
Labor, melting and pouring	.20
Charcoal, at 2c. per lb.	.0025
Electrodes	.05
Refractories	.01
Heating ladle and molds	.02
Total	$0.7725

Arrangement of a Silver-Melting Outfit

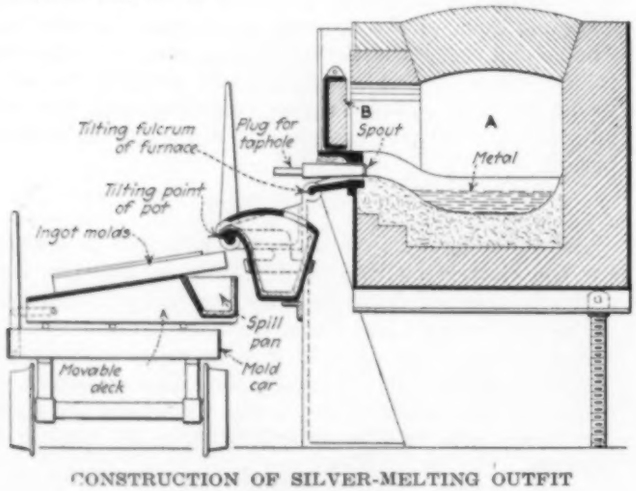
As previously intimated, the handling of the metal after it comes from the furnace is of just as much importance as the melting itself, and the writer herewith will give a design[1] as to how an efficient silver-melting outfit should be constructed:

A is a lip-tilting electric furnace which is charged through door *B*. A special lined taphole and spout are placed directly beneath the charging door. During pouring the door remains closed and the metal flows through the taphole into a lined pot or crucible hung in front of the furnace. The crucible or pot is provided with a cover and sets into a ring so that the entire pot is removable. Before using it should be thoroughly preheated and it should be of sufficient capacity to hold enough metal to fill one or more molds. The pot is also lip-tilting and is worked with a lever. In front of this pot runs the mold car, provided with a deck which can be moved back and forth by a lever. Under the lip of the mold car is placed a spillpan, into which also is poured any surplus metal from the pot.

As mentioned before, it will not do to leave any metal in the pot and pour new metal on top of it. If insufficient metal is left in the pot to complete a mold, it should be poured into the spillpan and remelted afterward.

The operation of this equipment is very simple and the operator will get used to it very quickly.

[1]Patent applied for.



CONSTRUCTION OF SILVER-MELTING OUTFIT

Comparison of Electric and Crucible Silver

Comparing now the quality of the electric silver produced by this method with standard-grade crucible silver, we get some very interesting figures. The electric silver and the crucible silver were submitted to various tests with the following results:

I. *Fracture.* Electric silver of much finer grain than crucible silver.

II. *Rolling.* Electric silver easier to roll.

III. *Stamping.* Electric silver stamped perfectly.

IV. *Deep Forging.* Extreme test; 100 per cent sound forgings from electric silver against 15 per cent from crucible silver.

V. *Spinning.* On the same extreme long draw, crucible silver failed completely, whereas electric silver came out 100 per cent perfect.

Magnesium Carbonate in the Glue Industry

Light carbonate of magnesia is a material which should be of interest to manufacturers of glues and mucilages, since it is of value as an opaquing agent. For such a use there is required a finely-divided, white, inert pigment, and magnesium carbonate has been shown, by a preliminary investigation at the Mellon Institute of Industrial Research, to meet these requirements. The material has a decided cost advantage over zinc oxide used for the same purpose, owing to the fact that it has a specific gravity of only 2.2, as compared to 5.78 for zinc oxide. Since the opaquing or pigmenting effect is determined on a volume basis, both the zinc oxide and magnesium carbonate being insoluble in the material in which they are suspended, the magnesium carbonate would be about one-third as expensive to use as zinc oxide, where the price of these two materials is the same per pound. The low specific gravity and bulky crystalline form of magnesium carbonate cause it to settle very slowly when suspended in a viscous material, while zinc oxide, having much higher specific gravity and being more compact in the form of its particles, will not remain suspended so long.

Glues from different materials vary so in composition that it will be necessary to study the effect of each glue on this pigment, owing to the fact that in certain cases impurities may cause agglomeration and rapid settling of the pigment. Magnesium carbonate is basic in character and will, of course, be dissolved by large percentages of acid in glue, but the same is true of zinc oxide. Further information with regard to this material may be obtained by addressing the Director of the Mellon Institute of Industrial Research, University of Pittsburgh, Pittsburgh, Pa.

A Discussion of the Slip Interference Theory of Hardening

Professor Sauveur Is Prepared to Accept the Idea That Martensite Contains Alpha Iron, but Wishes More Evidence on the Contention That Its Hardness Is Due to Sub-Microscopic Grain Size, and That Cementite in Solid Solution Is Dissociated

BY ALBERT SAUVEUR
Professor of Metallurgy, Harvard University

IRON containing a sufficient proportion of carbon, cooled with sufficient rapidity from a sufficiently high temperature, increases intensely in hardness. No such increase in hardness resulting from like treatment has ever been observed in any other metal or alloy. Strenuous efforts, experimental and mental, have been exerted by several generations of metallurgists to explain so important and unique a phenomenon. The metallurgical world was for a long period of time satisfied with the vague statement that quenched steel was hard because of the presence of "hardening" carbon, although at an early date the possible influence of severe internal strains was recognized. For a full score of years—namely, from about 1895 to about 1915—various theories were proposed to explain the hardening of steel, their discussion at times being conducted with considerable heat. By some the problem was taken from the domain of the laboratory to the quiet of the study, and several "desk" theories were added to those already under consideration. Activity in this field of research dates back to Osmond's epochal discovery of the allotropic transformations of iron and was further kindled by metallographic progress and by the application of the phase rule of Gibbs to metallic alloys. The theories that have been discussed include the "beta iron theory" of Osmond, the "alpha iron-solid solution theory" of Henry Le Chatelier, the "amorphous iron theory" of Humfrey, the "sub-carbide theory" of Arnold, the "stress theory" of André Le Chatelier, the "interstrain theory" of McCance and the "twinning and amorphous iron theory" of Carpenter and Edwards.

APPARENT STALEMATE

In 1915, summing up a short discussion of these theories, I ventured the following remarks: "It would seem as if the methods used to date for the elucidation of this complex problem have yielded all they are capable of yielding and that further straining of these methods will only serve to confuse the issue, a point having been reached when this juggling, no matter how skillfully done, with allotropy, solid solutions and strains is causing weariness without advancing the solution of the problem. The tendency of late has been to abandon the safer road of experimental facts and to enter the maze of excessive speculation, in which there is great danger of some becoming hopelessly lost. The conclusion seems warranted that new avenues of approach must be found if we are ever to obtain the correct answer to this apparent enigma."

The following remarks of Portevin and Garvin[1] are also to the point: "It is needful to guard against hypotheses which depend on the effect of an immeasurable quantity, as there is always a temptation to attribute to it values favoring *a priori* conception, and to give to a *petitio principii* the appearance of a demonstration. It is from such methods of reasoning that the interminable disputes relating to theories of quenching have arisen, which have no likelihood of ending so long as they rest on such foundations."

The relative calm which for the last five or six years has prevailed in a previously turbulent sea has been brought to an end by the presentation of a new theory of hardening by Dr. Zay Jeffries and R. S. Archer, called by them the "slip interference theory."[2]

The temptation is very great, and the danger also, to accept the authors' new theory, to declare the problem solved and to turn one's attention to others still unsolved and less elusive. O that this could be done! Any pretence, however, at scientific thinking carries with it its obligations, and one is compelled before accepting the newcomer to examine him critically to ascertain whether he is in reality a more sturdy and promising youth than his older brothers.

I desire at the outset to express my admiration for the mastery and skill with which the authors present their theory. Theirs is a brillant thesis which discloses their erudition and scientific acumen.

OUTLINE OF THE NEW THEORY

The authors define hardness as "resistance to permanent deformation," which in turn results from the attractive forces between their atoms or interatomic "bonds." To deform the metal permanently we must break up some of the interatomic bonds. This definition of hardness can be accepted as accurate, although it would serve as well as a definition of elastic limit and although of two metals the one having the higher elastic limit has not necessarily the greater hardness.

The authors state that increased hardness implies increased resistance to slip, or "increased slip interference." Since it is generally accepted as proved that when a metal or alloy made up of crystalline constituents is permanently deformed, the deformation results from slips having taken place along some planes of weakness of the crystal which may be cleavage planes, it necessarily follows that increased hardness (since it means increased resistance to permanent deformation) results from greater resistance to slip—i.e., to greater "slip interference"—and that any factor tending to produce greater "slip interference" increases the hardness of the metal. The proposition is not of course applicable only to the authors' theory; on the contrary, it fits in with any theory of hardening, since it is based on the definition of hardness and on the manner in which crystalline metals yield on being permanently deformed.

The following factors, according to the authors, may be considered as increasing slip interference and therefore increasing hardness: (1) Boundaries of crystalline

[1]Iron and Steel Institute, May, 1919.

[2]CHEM. & MET. ENG., June 15, 1921, vol. 24, pp. 1057 to 1067.

grains—from which it would follow that the smaller the grain the harder the metal, since a smaller grain implies a greater number of boundaries; (2) possible presence of amorphous metal at the boundaries, intensifying their slip interference action; (3) the slip bands themselves, from which it follows that a metal increases in hardness on being permanently deformed; (4) the possible presence of amorphous metal at the slip planes, intensifying their slip interference action; (5) twin crystals—by opposing slip propagation in the crystal in which they occur; (6) the presence of foreign particles acting as "keys" in obstructing slip, an action which is the more marked the smaller the particles and the greater their number, this rule, according to the authors, reaching its limit as the particles approach atomic dimensions, and the hardening effect being maximum for what they term "critical dispersion."

Nature of Martensite Must Be Adequately Set Forth

The authors attribute the hardness of quenched steel to the hardness of martensite. This statement can be accepted without discussion. Any theory of hardening necessarily makes the same claim. It is only in regard to the nature of martensite that they differ. Martensite is claimed by the authors to be a solid solution. The same claim has been made before by others. Many have believed with Osmond that martensite is a solid solution of carbon or of the carbide Fe_3C in beta iron, while others prefer with Le Chatelier to consider it as a solid solution of carbon or the carbide in alpha iron. Again, those who, like McCance, Carpenter and Edwards, are inclined to attribute the hardness of quenched steel to "interstrain," to twinning or to the presence of amorphous metal also consider martensite as a solid solution. The belief, therefore, that martensite is a solid solution is quite general and has been held for a long time.

Of necessity martensite must be (1) a definite chemical compound, (2) an aggregate, or (3) a solid solution. That it is a definite chemical compound, $Fe_{11}C$, containing iron in solution in hypo-eutectoid steel and Fe_3C in hyper-eutectoid steel, has been maintained by Arnold. The improbability of this hypothesis is so great that it may be dismissed without reviewing the arguments that have been so often offered in opposition. To decide whether martensite is a solid solution or an aggregate we naturally turn to the microscope, because we know what should be the appearance of a solid solution. We have been told and have frequently observed that solid solutions are made up of polyhedral crystalline grains corresponding to so-called "network" structures in polished plane surfaces. We fail, however, to observe under the microscope any such structure. Instead we discover that martensite has an "acicular" structure and we are unable to detect any suggestion of the existence of polyhedral grains. Our first impulse, therefore, would be to conclude that martensite is not a solution. The improbability of its being an aggregate, however, is so great that in spite of its structure we are reluctant to abandon the view that it is a solid solution and we try to find a satisfactory explanation for its acicular aspect. Carpenter and Edwards, for instance, contend that the "needles" of martensite correspond to austenite twins caused by the internal straining of the metal during quenching.

The authors of the theory under discussion express their belief that grains of martensite exist but that they are sub-microscopic—that is, too small to be observed under the microscope. Indeed they consider this extremely small size of the grains of martensite to be the chief cause of its hardness. I do not understand that they offer any explanation of its acicular appearance.

While not denying that the weight of evidence supports the contention that martensite is a solid solution, it should be borne in mind that the conclusion rests on a process of elimination—that is, on our justified unwillingness to consider it an aggregate or a definite chemical compound—rather than on direct proofs, and furthermore, that it is not supported by the appearance of martensite under the microscope.

Must a Compound Dissociate on Entering Solid Solution?

The authors argue that a metal holding another metal or metalloid in solid solution is harder than the pure metal. They write: "It is a general rule that metals are hardened and strengthened by the addition of elements which dissolve in them to form solid solutions." This they explain on the ground that intermetallic compounds are not dissolved as such in solid solution, but first must be dissociated to be held subsequently in solution in "atomic dispersion." To clarify: The definite intermetallic chemical compound $M_xM'_y$ of two metals M and M′ cannot form a solid solution with either of the metals; it is the metal M′ in its elementary state that is dissolved in M, or *vice versa*. "The increased hardness and strength," they write, "are therefore traceable directly to increased interatomic forces, the attraction between unlike atoms being in general greater than between like atoms."

In order to follow the authors' demonstration of their theory, therefore, it is necessary to accept their views, (1) that an intermetallic compound cannot be held in solid solution in a metal and (2) that interatomic bonds between unlike atoms are stronger than between like atoms. In support of their first contention we are told that intermetallic compounds could not, because of their size, diffuse through the solvent metal. Applying this view to the solid solution of carbon in iron, they write: "Diffusion must consist in a migration of carbon atoms and not of groups or 'molecules' containing several iron atoms. Such groups could not, on account of their size, diffuse through solid iron."

While not in a position to deny such claims, I believe that others will agree with me that before accepting as a demonstrated fact that intermetallic compounds cannot exist in a state of solid solution in a metal, more conclusive evidence should be forthcoming. The question is too important to be considered settled by the single argument of the authors. Their claim leads to many deductions requiring explanations. To mention but one: It is fairly conclusively established that silicon is present in iron as the silicide FeSi and it was generally believed that this compound was held in solid solution by the iron. According to the authors' view, however, this could not be; the compound must first be dissociated and silicon must be present in atomic dispersion. The silicide is, however, found in the steel at room temperature. When then did it form and where the evolution of heat that should accompany its formation? Such examples could be multiplied.

In regard to the statement that interatomic bonds between unlike atoms is greater than the bonds between like atoms, from which it follows that solid solutions

must be harder than the solvent metal, supporting evidences should be offered. If physical chemists have demonstrated this to their satisfaction, their proof should be given or at least the reader should be given the necessary references.

The Iron of Martensite Is Admitted to Be in the Alpha Modification

The authors' theory, therefore, postulates as demonstrated facts, (1) that martensite is a solid solution, (2) that in martensite carbon in its elementary form and not the carbide Fe_3C is dissolved in iron, and (3) that solid solutions are harder than the solvent metal because of the greater interatomic bonds existing between unlike atoms, from which it follows that martensite must be harder than iron. We are justified, I believe, in accepting these conclusions with some reservation, especially in regard to claim 2.

We are further told by the authors that iron in martensite is present in its alpha form. This has long been the contention of Le Chatelier and of some other metallurgists. The additional evidence offered by the authors in support of this view is stated by them as follows:

"The X-ray spectrometer proves that alpha iron is the chief constituent of martensite. Steels which are non-magnetic show face-centered cubic lattices with the X-ray spectrometer, whereas martensite, which is magnetic, shows a body-centered cubic lattice. A 1.5 per cent carbon steel quenched from above the critical in iced brine showed both martensite and austenite under the microscope, and the X-ray spectrometer pattern showed both face- and body-centered lattices. A 0.35 per cent C steel quenched from above Ac_2 showed only martensite under the microscope and only a body-centered lattice with the X-ray spectrometer."

This proof of the presence of alpha iron in martensite and of the absence of gamma iron is considered definite and final by the authors. The conclusiveness of the evidence depends altogether upon the faith we have in the results yielded by the X-ray spectrometer.

I am not in a position to take issue on this point with the authors, nor do I desire it—on the contrary, I am quite prepared to accept the correctness of their view.

Jeffries and Archer's View of Martensite

Admitting then that martensite is a solid solution of elmentary carbon in alpha iron and that because it is a solid solution it must be harder than pure iron, we are told that this is only a contributory and relatively unimportant cause of its hardness—that its extreme hardness is due primarily to the *size* of its grains, which are described as "sub-microscopic." We naturally infer that if pure iron could be obtained in sub-microscopic grains it would be quite as hard as quenched steel.

To account for the formation of these sub-microscopic grains the authors argue that when austenite is transformed into pearlite at its normal critical temperature, two distinct transformations take place: (1) the allotropic transformation of gamma into alpha iron, *followed* by (2) the combination of carbon with alpha iron to form Fe_3C. They write: "The latter would not form unless the iron changed its crystal structure. Therefore the allotropic transformation of the iron is the cause and the formation of cementite is the result. . . . When austenite is slowly cooled through A_1, the two changes occur so close one after another as to be called simultaneous. . . . *When the cooling rate of the austenite is sufficiently rapid to form martensite, the transformation of the gamma iron to alpha is substantially complete, whereas the formation of cementite is not complete.* Martensite should therefore consist principally of sub-microscopic ferrite grains containing carbon in solution. . . . Although the ferrite of the martensite is held to contain carbon in solution, it is considered that the fineness of grain is chiefly responsible for the hardness." And again: "The hardness of martensite may therefore be attributed chiefly to a combination of two factors—namely (1) the super-refinement of the ferrite grains, and (2) the strengthening of ferrite by carbon."

The authors' theory therefore rests on the formation of sub-microscopic grains on quenching steel, and the following reasons are given by them in support of their contention:

"1. The conditions obtaining at the time of the formation of martensite are conducive to the production of small grains.

"2. In low-carbon martensite formed from coarse-grained austenite, ferrite can often be seen under the microscope in the form of very small plates.

"3. In higher carbon steels which are conducive to the formation of finer grains on quenching, no ferrite can be resolved under the microscope.

"4. In order to obtain a good Hull pattern with the X-ray spectrometer it is necessary that the specimen be fine-grained. In a 0.35 per cent C martensite, formed by quenching from 1,300 deg. C., the alpha iron pattern was typical of that obtained from fine-grained metals, even though the austenite grains from which the martensite was formed were large enough to be seen with the unaided eye."

More Evidence Needed

Without any desire of being hypercritical I do not think that these reasons can be accepted as at all conclusive of the existence of sub-microscopic grains in martensite, and since they are essential to the theory proposed by the authors, it is in order that we should demand more convincing evidence.

The part played by carbon in the hardening of steel is thus described: "The presence of the carbon assists in the hardening indirectly by helping to produce a very fine ferrite grain size and directly by strengthening the ferrite grains." The authors face here the same difficulty as was encountered by their predecessors. The action of carbon is indirect, we are told—it helps in producing microscopic grains. The argument recalls the claim of the allotropists that carbon *helps* in retaining beta iron, a claim which has always been considered one of the most vulnerable points of the theory. Arnold, of course, took the bull by the horns in assuming the existence of a very hard carbide of iron ($Fe_{24}C$), but then his theory is untenable. Assuming, as we must, that carbon helps in the production of fine grains, the mechanism of the assistance rendered is not satisfactorily explained, if explained at all.

While appreciative of the talent and skill with which the authors present their theory of the hardening of steel, some of us, I believe, will hesitate to accept it as a fully satisfactory and final solution of the problem, because we are asked to accept as a demonstrated fact, without being given sufficient evidence in support of the contentions, that an intermetallic compound cannot exist in a metal in a state of solid solution, and that the carbide Fe_3C, therefore, cannot be present in solid

solution in gamma or alpha iron; because we are asked to accept as a demonstrated fact that in martensite grains of alpha ferrite exist in sub-microscopic dimensions without being given convincing evidences of that important, and to the theory essential, phenomenon; because, referring to the rôle played by carbon in the hardening of steel, we are asked to be satisfied with the rather vague statement that carbon helps in producing sub-microscopic grains without any explanation of the mechanism of this action; and because the theory does not satisfactorily explain why sub-microscopic grains and therefore hardness cannot be obtained in other metals and alloys by quenching.

We further hesitate to accept the theory as final because the authors reopen wide the doors of speculation. It might be claimed, for instance, that martensite is hard simply because it is a solid solution of alpha iron and carbon in atomic dispersion, the carbon atoms acting as "keys" (to use the author's expression), from which it would follow that the more carbon—that is, the more keys—the harder the martensite. Could not such a theory be defended vigorously and cogently? It would at least have the advantage of offering a more acceptable explanation of the need of carbon to harden steel and of the absence of hardness in the absence of carbon. This, of course, would be a return pure and simple to Le Chatelier's theory.

Legal Notes

By Wellington Gustin

Utzman Patents for Gypsum Plaster Board Held Valid

Two patents, 1,029,328, covering a process for making plaster board, and 1,034,746, covering the product, the plaster board, were the subject of an infringement suit decided recently by the United States Circuit Court of Appeals, Seventh Circuit, United States Gypsum Co. vs. Bestwall Mfg. Co., 270 Fed., 542. The court affirmed the District Court's decision that the patents were infringed.

The patentee says he aimed to construct a board "the edges of which will be entirely inclosed by a sheet of covering material and in which there will be no free or exposed edges of covering material which will be liable to be torn, loosened or pulled back in the handling of the board."

It appears, therefore, that the virtue of the patent is found in the protection which the covering over the edges affords. And there was evidence to support the claim that such covering protected the exposed edge of the gypsum body, prevented waste, strengthened the finished board, increased the output, improved the appearance of the finished product and reduced the cost of production. A very large increase in the production of plaster board followed the appearance of this patented article.

Plaster boards of the two-ply and of the composite type were old and well known at the time of this discovery, says the court. The advance over the prior art consists chiefly in the protection afforded the edges of the gypsum.

The process is described by counsel as follows: "The patented method consisted, broadly, in pouring a mass of semi-liquid flowing material upon a rapidly moving continuous sheet of paper, folding the edges of such strip upward and inward over the edges of the layer of plastic material, superimposing a narrower continuous sheet of paper upon the bottom sheet and the layer of plastic material thereon, and passing the whole between a pair of pressure rollers, whereby the layer of plastic material is compressed to a uniform thickness throughout the width of the paper where its edges are confined and bound by the inturned edges of the bottom sheet, whereby the superimposed upper sheet is secured to the layer of plastic material and to the inturned edges of the bottom sheet by the adhesiveness of said material itself."

The evidence showing the extensive use that immediately followed the appearance of the new board the court thought was sufficient to show its utility. One issue alone was presented the court: Does the contribution of the patent spell invention?

Question of Invention Raised

Utility, increased output, improved product, reduction in cost, are all factors that have been thrown into the scale and are somewhat determinative of this issue, as the court saw it. But the Court of Appeals did not agree with counsel for patentee that this patent was a "broad novelty," nor with its expert witness that it was a "daring conception." And it says invention is not determined by the extent of the advance in any art which the inventor makes.

In this suit the court found that the use of a covering as a retaining member with its resulting advantages heretofore enumerated was novel. Moreover, to utilize the plastic material thus inclosed as an adhesive material, in securing the edges of the retaining member, and to attach the top cover member to it as described in the process were novel and somewhat ingenious. Such double use of the plastic material together with the retaining member permitted the manufacturer to increase its output, to lessen the cost of production, to make a more sightly board which "chipped" less readily than the board previously used, all of which under the circumstances the court held to be novelty amounting to invention.

The process patent used the term "alternate layers of plastic material," and the Bestwall company's claim of non-infringement was based in part on the assertion that its product does not contain "alternating layers of plastic material" nor are they used in its process, but the board is made in a single plastic layer.

In reply to this the Gypsum company contended that the building up of the body of the board in alternate layers of plaster and paper was not of the essence of the invention, but that the really new things discovered by Utzman were the upturning of the edges of the bottom layer of paper and then sealing or impressing the top layer of paper, a little shorter than the completed board, over the upturned ends of the bottom layer and into the layer of plaster. There is a rule of law laid down in another case (120 Fed., 260) to the effect that an element of a claim not essential to the result which the inventor desired to accomplish is not absolutely requisite in an infringing device. Therefore it was contended that since the construction in alternate layers not being essential to the result which the inventor Utzman wishes to reach, the fact that the defendant does not use alternate layers in its board is immaterial.

The Use of Inert Gas for the Prevention of Explosions

Complete Combustion of Coke in a Specially Designed Generator Gives a Mixture of Carbon Dioxide and Nitrogen Which May Be Employed Effectively for the Prevention of Explosions—Tests With Sulphur-Dust-Laden Atmospheres

By EDWARD F. WHITE

EXPLOSIONS in industries are not always the result of failure to recognize the flammability of the materials used or the means available for the prevention of fire.

Many manufacturing operations, involving the separation and synthetic compounding of different elements, require the handling of flammable, gaseous and pulverized materials, in processes wherein it has been impossible to guard successfully against accidental fire and explosions. For this and many other reasons it cannot be asserted that a possible means for providing against explosions is available for every case. There are, however, many instances of recurrent disastrous explosions which might never have occurred if available and well-understood means for prevention had been employed.

The purpose of this discussion is to call particular attention to one such means—namely, the use of inert gas as CO_2 plus N_2 manufactured on the premises for the purpose by burning coal or coke in a suitably arranged apparatus, so that the products of combustion containing no free oxygen are collected in a holder to be drawn from as called for. This, in the writer's opinion, may in many cases be even more effectively employed for the *prevention* of fire than it has been as forming the basis of operation in the modern fire extinguishers now for many years. It is now a known fact that in many dust-making operations, including such as involve the use of dust collectors, dust flues, inclosed elevators and conveyors, pulverizing and disintegrating machines, the circulating, dust-laden atmosphere can be made inert, that is to say, deprived of free oxygen to an extent sufficient to make the existence of fire an impossibility. Reference is made to this particular line because it is one of the most prolific fields of disastrous fires and explosions and offers the most ready and convenient opportunity for the application of the inert gas preventive. The handling and milling of grains, manufacture of food products, the grinding of sugar, starch, castor oil meal, spices, chemicals, coal, wood and other carbonaceous materials, develop dust products which ignite and propagate flame readily.

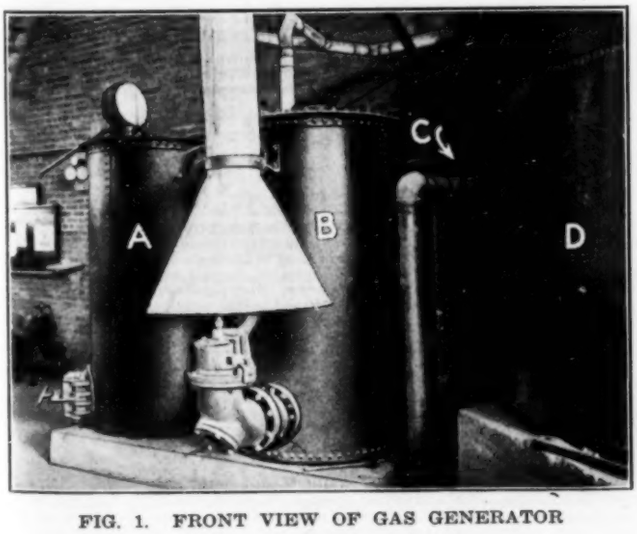


FIG. 1. FRONT VIEW OF GAS GENERATOR

Some interesting information is here given concerning the use of inert gas in the manner above described, to prevent the explosion of sulphur dust in a milling process involving the use of all the types of machinery above referred to with result of preventing absolutely explosion of the sulphur in any parts of the operations or machinery, so long as the gas was maintained and used in the manner planned for and specified to be used.

Inert Gas Generator

The gas-making plant (Figs. 1 and 2) consists of four principal parts—namely, the primary generator *A*, a secondary generator *B*, a combination gas scrubber and cooler *C* and a gas holder *D*. In operation fire with coal, or preferably coke, produces the initial gas (products of combustion) in the primary generator *A*, which is a closed furnace with controlled air supply under pressure of about 4 oz. per sq.in., furnished by an ordinary pressure fan blower. The products of combustion pass from the top of the primary generator into the secondary generator, in which they mix with a further supply of air, regulated for complete combustion, the heat of combustion of which maintains the checker work filling of the secondary generator at a dull red heat, so that the gases leaving the secondary generator consist only of completely oxidized combustion products and nitrogen. The gases now pass into the scrubber and cooler through a cold water spray and layer of broken coke, being freed thereby of any dust mechanically carried over in the gas, cooled and delivered into the holder ready for use.

A plant of the above description for the production of 3,000 to 5,000 cu.ft. per hr. of inert gas is operated with labor only for fueling say three or four times in 24 hr., the cleaning of the fire and removal of ashes, perhaps twice daily, and a sufficient general oversight while running to maintain the correct air supply and testing of the gas (which latter may be automatic and continuous) to secure uniform production.

From various records of operations in the writer's experience, the following practical observations are noted:

An ordinary disintegrating mill of capacity 1 to 3 tons per hr. will have sufficient supply of inert gas

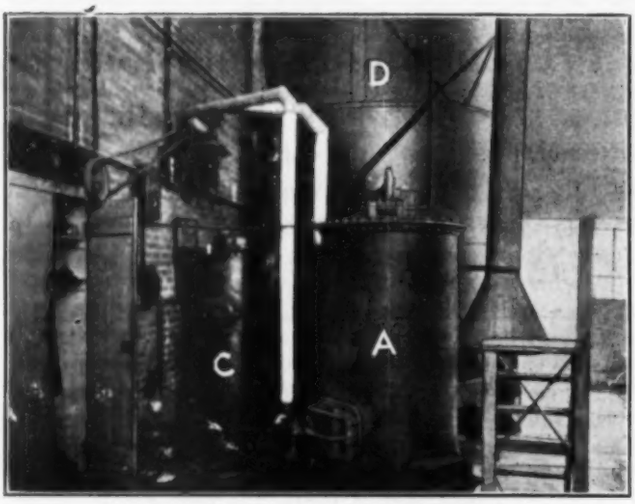


FIG. 2. SIDE VIEW OF GAS GENERATOR

through a ½- to ¾-in. globe valve if the gas pressure at the valve is about 3 oz. per sq.in.

A large tight housed bucket elevator, with single leg say 50 ft. head to boot shaft, will have a sufficient supply of inert gas through a ½- to ¾-in. globe valve if the pressure at the valve is about 3 oz. per sq.in.

A 500-cu.ft. floating bell gas holder will supply gas through a ¾-in. globe valve for about 1 hr.

A standard Gas Engineering Co. 36-in. gas-generator set will fill a 500-cu.ft. bell holder in from 5 to 10 min., under normal conditions, according to openings given to combustion air valves.

Fuel consumption, if coke, with 36-in. set above referred to, operated at normal rate, will be about 50 lb. per hr.

Estimated cost of 1,000 cu.ft. gas, if coke costs $20 per ton, about 8c.

As a matter of interest in connection with the study of explosions and means of preventing same, some helpful information is given below as obtained by the writer's investigations experimentally to determine the nature of and how to remedy explosions in the process of handling sulphur. The tests were with a special outfit set up for the purpose, as shown in Fig. 3, and described hereafter.

The questions to which answers were sought by the experiments may be stated as follows:

In a sulphur-dust-laden atmosphere, what proportion of sulphur dust in the air makes an explosive mixture?

What conditions seem especially noticeable in the propagation of fire in such atmosphere, particularly as to the extinguishing effect of the products of combustion resulting from the first burning and in the immediate vicinity of the place of ignition, the question being whether the explosion, or more specifically, the effect of a rapidly propagated fire—which an explosion is—may not be prevented by a partial elimination of the free oxygen as affecting the whole circuit by selecting effective places for injecting the gas.

What per cent in mixture of CO_2 and air will positively prevent fire regardless of fineness and per cent of sulphur present, as might be caused in any confined space from a spark caused by the striking of fire; e.g., in the disk chamber of a mill or by static or dynamic electricity.

What temperature and pressure conditions result from explosions with various mixtures of air and sulphur dust more or less confined as to circulation, as compared with theoretical calculations therefor for the known quantities of combining elements present, all as indicating the probable amount of sulphur oxidized and extent or distance reached by the fire.

The explosion chamber was a piece of 10-in. wrought-iron pipe about 4 ft. long, threaded and fitted at each

RESULTS OF EXPLOSION TESTS WITH SULPHUR-DUST-LADEN ATMOSPHERES

Test Series No.	Purpose of Test	Apparatus Conditions	Ignition	Atmosphere in Chamber	Temperature of Explosion	Pressure of Explosion	Observations	Conclusions
1	To explode measured equivalents of sulphur and oxygen.	Chamber closed, dusting by means of fan agitation.	Could not ignite.	Air	.....	.....	Saw good spark before closing chamber.	As repeated and sustained spark acting before and after and during running of fan failed to fire, evidently the intimacy between sulphur and oxygen was not close enough for combination, due to not enough dust of proper fineness and too slight circulation in immediate vicinity of the spark.
2	To explode mixtures of sulphur in excess of air.	Same as above except cover loosely laid on, held down by 2 bricks.	Only when S was double or more than the calculated equivalent	Air.	Varied from slightly warm to quite warm.	Never enough to show on gage but lifted cover and 2 bricks.	Inside of chamber showed fire was where sulphur was thickest and near spark plug.	Low pressure resulted probably from only partial combustion, due to the smothering effect of products of combustion of initial fire in connection with slight circulation, which prevented bringing up of fresh oxygen into the field of ignition.
3	To observe effect of excess of air and circulation.	As above except used top and bottom air valves.	Every time with positive explosion.	Air.	Decidedly warm.	Caused hissing through valves.	Noticed marks of burning S all parts of chamber especially around spark plug.	During this series of experiments it was noticed that by leaving the vent (air) valves opened, and running the fan continuously, explosions occurred at fairly uniform intervals, longer or shorter, according to the amount of air passing and the time required for purging after each explosion, showing conclusively the effect of the products of combustion to prevent firing. Very positive marks of firing were noticed in all parts of the chamber, and the explosions were decided detonations. From this the propagating effect of the oxygen-bearing air to carry the fire to all parts reached is obvious.
4	To determine what proportion of CO_2 prevents explosion.	Same as in test No. 2	With less force as gas increased.	Air and CO_2	As before under like conditions.	As before under like conditions.	Checked gas per cent in chamber by laboratory test of sample.	20 to 25 per cent of CO_2 in air, at normal atmospheric temperature and humidity, will undoubtedly prevent explosion of sulphur dust by spark ignition from any cause or source. By CO_2 is understood ordinary commercial carbonic acid made by the elimination of free oxygen from air through a process of burning coal or coke. Such gas, of course, contains a large percentage of nitrogen.

NOTE.—The sulphur used in these experiments was crude brimstone, ground, dust-chamber separated, and bolted through silk about 120 mesh. A sample of the crude before grinding showed less than 0.8 per cent moisture. A good per cent was impalpably fine. The experiments were made out of doors, on the afternoons of two different days in September, 1920. The weather was clear, temperature about 70 deg. F. Humidity about 85 per cent of saturation.

end with a standard 10-in. pipe cap. An 8-in. disk fan was placed axially with, and near the bottom of, the chamber, on a shaft journaled through the bottom cap and fitted on the outside end with a pulley for driving by an electric motor. This fan acted as an agitator for the sulphur and served also to excite a circulation of the atmosphere inside the chamber. The top cap was removable by unscrewing and during the trials was replaced by an asbestos-paper-lined light wooden cover laid on and held down with two common red bricks. Both top and bottom covers were fitted with 1-in. globe valves for the passing of the atmosphere into or out of the chamber. The ignition was by means of an ordinary series group of dry batteries (about 8) and an ordinary spark plug, the latter being placed in the side of the chamber about midway between top and bottom; also in the side of the chamber

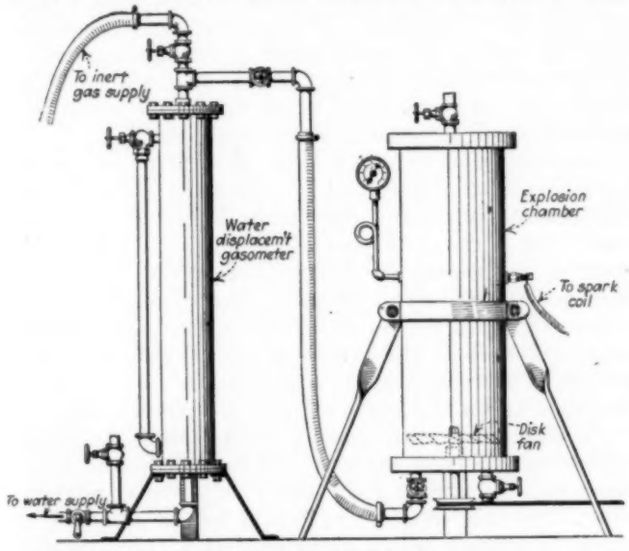


FIG. 3. APPARATUS FOR EXPLOSION TESTS WITH SULPHUR DUST

opposite the spark plug was a pressure gage, near which was an opening fitted with a valve for admitting inert gas. The inert gas used was CO_2, taken from a gas cylinder through a water displacement gasometer. The sulphur for dusting was dropped into the chamber by removing the top cover while the fan was not running.

Some variations of conditions were made during the trials, most important of which were as follows:

Sparking was done both with fan running and not running; that is to say, immediately following the stop and start of the fan;

The chamber was placed alternately in vertical and horizontal positions;

Several trials were made with each change and also charge of sulphur, preceded in every case by removal of cover and purging of chamber, by doing which it was possible with marked accuracy to obtain repeatedly very similar effects, depending upon the conditions set;

The activity of circulation within the chamber was varied under control by means of the air globe valves at top and bottom of the chamber.

As only approximations to actual conditions were possible to observe, the conclusions are correspondingly of indicating or empirical value, but it is the writer's belief that significant inferences may be drawn by study of the accompanying tabulation of the results of the tests.

A Plan to Reduce the Time and Cost of Air-Seasoning Wood

In co-operation with the sawmills and wood-utilization plants throughout the country, the Forest Products Laboratory, Madison, Wis., is organizing an extensive field study on the air-seasoning of wood. This study, it is believed, will be of extreme interest to the lumber manufacturer and to the wood-using industries. The purpose is to determine the piling practice which will result in the fastest drying rates consistent with the least depreciation of stock, the least amount of required yard space and the lowest handling costs. The study will be carried on concurrently on both hard woods and soft woods.

The air-seasoning of wood is an old practice. No systematic attempt has ever been made, however, to work out the exact conditions under which drying time and drying costs can be reduced to a minimum. It is not actually known which of the numberless methods of piling will give the quickest and the cheapest results under given climatic conditions. The new project will furnish a comparison of the effects of such piling variables as sticker heights, the spacings of boards in layers, the heights of pile foundations and the directions of piling with relation to prevailing winds and yard alleyways.

The study is expected to decide whether from a business standpoint lumber should be dried partly at the mill and partly at the plant of utilization, or whether it should be completely dried at the mill. The data collected will also go a long way toward showing whether air-seasoning or kiln-drying is the more profitable.

A tentative working plan of the air-seasoning study has been prepared by the Forest Products Laboratory, and copies are being sent to the secretaries of the various lumber and wood-using associations, state foresters, forest school heads and others.

Co-operation in the air-seasoning study is being offered on every side. As yet the plants at which the work will actually be done have not been definitely chosen, but the extreme interest already manifested indicates that there will be no difficulty in securing co-operation with plants ideal for the study. Actual field work will soon be well under way.

Estimated Production of Iron and Steel in Japan

The recent report of the financial and economic committee appointed by the Japanese government to study the future development of the mineral production of the country, as published in the *Far Eastern Review*, gives the following forecast of the production of iron and steel for the five years mentioned and of the coal and iron ore required under peace conditions:

Years	Production		Requirements	
	Pig Iron Tons	Steel Tons	Coal Tons	Iron Ore Tons
1920	377,616	1,031,550	6,040,000	3,709,000
1921	468,000	1,099,000	6,473,000	3,978,000
1922	437,000	1,164,000	6,926,000	4,275,000
1923	466,000	1,227,000	7,339,000	4,517,000
1924	492,000	1,287,000	7,733,000	4,786,000

The committee considers that the best policy to follow is the grouping of the various works and the levying of protective tariffs ranging from 10 per cent *ad valorem* on iron ore to 15 per cent for steel, material for ship construction remaining free as at present. The builders using native steel would receive a subsidy equivalent to the import duty.

Casting Aluminum:Zinc Alloys

By F. A. Livermore

ALUMINUM, as a material for casting, presents many advantages as regards lightness, good machining properties, a fair amount of strength and freedom from brittleness, the widespread adoption of aluminum alloy castings of recent years sufficiently demonstrating their reliability to withstand severe service.

It is a well-known fact that pure aluminum is entirely too soft to produce satisfactory castings which will be subject to any strain, owing to its comparative softness and lack of strength. To overcome this it is the universal practice to stiffen the metal with some hardening element, the amount and nature of the hardening element or elements depending on the physical and mechanical properties required.

Practically all the standard aluminum alloys used in the foundry can be successfully cast, but there are two main classes of aluminum casting alloys:

(*a*) Those whose principal hardening medium is zinc (with or without small percentages of other elements).

(*b*) Those containing copper as the hardening constituent.

We find class *a* extensively used in British aluminum foundries, while the copper alloy is favored by the French and American foundries.

Aluminum:zinc alloys have the reputation of being particularly subject to fatigue failures; this is due to the weakening effect of certain impurities of commercial spelter. Lead in particular is very deleterious to any aluminum alloy, and when castings of the zinc base alloy are required to pass severe physical tests, only high-grade zinc should be used. Other dangerous impurities are carbon, silicon and iron, hence the greatest precaution should be taken to prevent the introduction of this foreign matter either in the metal used or through the medium of crucibles and tools.

Precautions to Be Taken in Melting Aluminum Alloys

In melting aluminum alloys, plumbago or salamander crucibles (preferably with clay liners) should be used.

Melting is best carried out in a gas-fired furnace using a mixture of air and gas which can be adjusted to prevent overheating and subsequent burning of the metal. Electric furnaces are claimed by their proponents to be when properly made much more reliable and cheaper than the gas furnace or any other type of furnace. No charcoal or carbonaceous covering is used on the metal, as carbon combines with the alloy, forming a very brittle compound. Gates and sprues from castings must be freed from sand as nearly all the sand introduced into the pot is reduced to silicon, which weakens the alloy. In cases where there is a great danger of introducing sand, it is found beneficial to add powdered flux (75 per cent of potassium chloride and 25 per cent fluorspar). This tends to dissolve the silica and so keep it from combining with the aluminum.

It is found that a tough film of oxide often surrounds borings, turnings, chips and other scrap aluminum, making it extremely difficult for melting. This oxide can be dissolved off by heating with the alkali earths. The following process is recommended by the British Aluminum Co., Ltd.: The chips or other fine scraps are intimately mixed with varying amounts of flux (85 per cent of common salt and 15 per cent powdered fluorspar) depending upon the degree of cleanliness, and the whole is melted at a fairly high temperature.

Special precaution should be exercised when melting to prevent overheating, as this appreciably effects and is injurious to the working properties of the casting. The pouring temperature has a very noticeable effect upon the resultant castings. In general, the temperature should be as near the melting point as possible. After a considerable amount of research I have found by adhering to this rule an increase of 8,000 lb. per sq.in. in tensile strength is obtained together with a marked improvement of the surface appearance of the casting. The temperature I recommend is 650 deg. C. ± 10 deg. C.

In quite a number of British foundries the archaic method of guessing the temperature by the eye is still in vogue, and I am confident that a large percentage of the unsound work produced is due to this, what I think we can call discrepancy or oversight. All aluminum castings should be under strict pyrometric control to obtain satisfactory results, and I may add that the outlay for the installation is quickly compensated by a corresponding increase in sound production.

Just before pouring, a little flux is added to the molten mass and the metal is thoroughy stirred with a clay-covered skimmer. Flux tends to reduce the oxides and dross in the metal and put it in ideal condition for pouring; otherwise the heavy oxide which is occluded throughout the metal would cause blow-holes. The dross which forms on the surface must be removed with special care; the skimming should be done with a degree of thoroughness, as a little dross is likely to remain under the surface and pass into the casting.

An aluminum casting has a characteristic cleanliness when removed from the mold and very little dressing is required. In grinding off any rough spots, workmen often find that the emery wheel has a tendency to gather particles which interfere with the grinding; I find that a little lard-oil or grease on the surface of the emery wheel will prevent this clogging and thus insure smooth cutting with maximum efficiency.

The difficulty of welding aluminum has been overcome by treating the surface to be welded with a mixture of alkaline chlorides and fluorides, which completely dissolves the film of oxides formed. In one method, a mixture of four parts of potassium chloride, three parts sodium chloride and one part of sodium fluoride with a melting point of about 660 deg. C. gives very satisfactory results.

Cracks, shrink-holes, pinholes or other defects can be filled by means of an oxy-acetylene blowpipe.

In connection with the work I have carried out on alloys of aluminum, I have found the laboratory an indispensable asset; the co-operation on the part of the chemist has elucidated difficulties which may otherwise have been left unsolved.

Notes on Oil Shale Industry

The Bureau of Mines has recently issued some notes on the oil shale industry which are preliminary to the publication of a general bulletin on this subject. The history of the industry and its status in Scotland and the United States are discussed, and the method of assaying oil shales used in the Bureau is compared with the procedure used by the largest of the Scottish producers. A selected bibliography of approximately a hundred references is appended.

Briquetting Mineral Phosphates

Reducing Conditions Being Essential in the Production of Phosphoric Acid by the Volatilization Process, the Authors Have Investigated the Briquetting of Mixtures of Florida and Tennessee Phosphates With a Reducing Agent (Coke, Coal, Peat)

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THE briquetting of metals or minerals for industrial use is practiced as a rule for one of two reasons: first, either to utilize natural deposits of finely divided minerals which must be in nodular or lump form in order to handle them with commercial success, or second, to eliminate the loss or waste resulting from other mining or manufacturing processes where large tonnages of ore fragments and metallic filings and trimmings are produced. In countries therefore where natural deposits of high-grade coal and metallic ores have become less plentiful the science of briquetting and the perfection of briquetting machinery have made their greatest advances. As an example of this the general type of machine so successfully employed in making fuel briquets was long known as the Belgian roll press, because it originated in Belgium.

While briquetting has been practiced in certain European countries for many years, it is a comparatively new development in the United States, largely because our natural resources have been so great that we have felt little need to economize or to utilize fully our industrial wastes. Up to the present most of our effort has been spent upon the briquetting of the dust and culm incidentally obtained in the mining and preparation of anthracite coal, and so successful has the briquetting of coal proved that, according to the figures of the U. S. Geological Survey,[1] our output in 1918 amounted to 477,235 net tons. With the gradual exhaustion of the cream of our better grades of ore, however, and an ever-growing tendency toward greater efficiency in industry, briquetting processes promise to occupy a much wider field.

According to Stillman[2] investigations have been made and considerable success has been attained in the briquetting of a great variety of materials, such as carbonized lignite, hard steel, copper and tin ores, hardwood, metal leaf, and paper, sawdust and copper, steel and brass trimmings.

Recent advances on a new process of producing phosphoric acid from mineral phosphates has made the briquetting of phosphate rock a matter of considerable interest, and it was with a view to determining how widely applicable this method might prove to our more important phosphate deposits that the work described herein was undertaken.

The Developed Phosphates of the United States

While the United States possesses larger known deposits of phosphate rock than any other nation in the world, our supplies at present are drawn from two main phosphate fields—namely, those of Florida and Tennessee. The deposits in our Western States (Utah, Idaho, Wyoming and Montana), though vastly greater than those in the East, are so far removed from the fertilizer market that they are being exploited at present to only a limited extent. In both Florida and Tennessee a considerable quantity of the higher grade rock has already been mined, and though these fields are by no means exhausted, very elaborate and costly mining methods must now be employed in order to obtain the grade of phosphate rock which the fertilizer operator demands for the manufacture of acid phosphate. Modern methods of preparing phosphate for the market involve washing and screening the rock, which entail a considerable loss of finely divided phosphate due to its discharge upon the dumps along with the impurities carried in the deposits.[3] The impurities thus removed are mainly silica and the oxides and phosphates of iron and aluminum, the first-mentioned being objectionable because of its diluting effect and the two latter chiefly because of the undesirable chemical and physical properties which they impart to the product.

The Volatilization Process of Obtaining Phosphoric Acid

The process which has been receiving considerable attention within recent years is that based upon the volatilization of phosphoric acid from mixtures of phosphate rock, sand and coke by heating such mixtures to smelting temperature. Since the presence of silica or silicates is essential to bring about the chemical reactions involved, it is not necessary to employ high-grade phosphate rock for this process—in fact, if the furnace plant is located at the phosphate mines, it would be a foolish practice to eliminate the silica present in the deposit by a costly washing and screening process only to put this material back in order to obtain the proper lime and silica ratio required in the furnace charge. Moreover, the presence of a relatively high percentage of aluminum oxide or phosphate or both is apparently an actual help to the successful working of the process, since these compounds tend to lower the melting point of the slag obtained and thus facilitate the escape of the phosphoric acid.[4] While the oxides or phosphates or iron are usually reduced to an iron-phosphorus alloy (ferrophosphorus), there is a ready market for this latter product and therefore the presence of iron in the phosphate deposit does not entail the loss of the amount of phosphorus equivalent to this metal.

Until the past year it was generally believed that the production of phosphoric acid by the volatilization process could be successfully and completely accom-

[1] Tyron, F. G., "Mineral Resources of the U. S.," pp. 33-36 (1920).
[2] Chem. & Met. Eng., vol. 22, No. 22, June 2 (1920).
[3] Waggaman and Wagner, *J. Ind. Eng. Chem.*, vol. 10 (1918), p. 353.
[4] Waggaman and Turley, *J. Ind. Eng. Chem.*, vol. 12 (1920), p. 646.

plished only in the electric furnace. Since phosphoric acid for fertilizer purposes must always be a relatively cheap product, it appeared doubtful if this process would have a very wide application in this country, because of the scarcity of cheap electric power. For this reason the Bureau of Soils in its laboratories for technical research undertook an investigation to determine if it were not possible to employ fuel for smelting mixtures of phosphate rock, sand and coke in lieu of the electric arc. This work has reached a status where it holds forth considerable promise of economic success,[5] but the data so far obtained indicate that the successful briquetting of mine-run phosphates is a factor of very great importance to the commercial practicability of the process in Florida and Tennessee.

Experiments have shown that in order to obtain complete volatilization of the phosphoric acid from such mixtures it is highly important if not essential that reducing conditions be maintained within the mass of reacting materials until the charge is brought to a state of incipient fusion. These conditions are not difficult to maintain in the electric furnace, where the heat required in the smelting operation is not dependent upon oxidation, but where fuel is used as a heating source, air or oxygen must be introduced into the furnace in order to obtain the heat units necessary to attain a smelting temperature. If reducing conditions are maintained in such a furnace by the incomplete combustion of the fuel, not only is it difficult to obtain the temperature desired but in furnaces of the ordinary type a great loss or waste of combustible material results.

Realization of Reducing Conditions by Briquetting a Mi ture of Phosphates and Coal

After a considerable amount of experimentation it was decided that the most feasible method of bringing about the desired reactions in such mixtures as outlined above was to employ fuel from an outside source for the heating of the charge but to mix coke or some other carbonaceous material intimately with the phosphate rock and sand to act as the reducing agent. Even under these conditions, however, considerable difficulty was experienced in preventing this reducing agent from burning out of the charge and thus bringing the reaction to a standstill.

The most efficient form of furnace yet employed in trying out this method has been of a type combining the features of both the open hearth and blast furnaces in which the gases of combustion ascend through the green charge preheating it to the necessary temperature before it is fed upon the hearth. Since the mine-run phosphates of Florida and Tennessee could not be treated in their natural state in such a furnace because of the difficulty of forcing the phosphoric acid evolved and gases of combustion through a column of finely divided material, it soon became apparent that such material must be either nodulized or briquetted to allow a free passage for the gases between the interstices of the green charge. It was also found that by intimately mixing finely ground coke or other carbonaceous material with the sand and mineral phosphates and pressing or molding the mass into lumps the bulk of the reducing agent could be protected against oxidation and thus held available to bring about the necessary chemical reactions in the furnace. Because of the nature of the Florida phosphates and certain advantages which fuel offered as a heating agent over the electric arc, briquetting appeared to be more feasible than nodulizing. According investigations were undertaken to determine the most economic methods of making briquets from mixtures of phosphate rock, sand and coke for subsequent furnace treatment.

Binding Material a Prime Factor in the Briquetting of Minerals

Investigations so far conducted on the briquetting of coal and lignite[6] seem to show that the nature, quantity and value of the binder employed are the factors of prime consideration. The requirements which such a binder must fulfill are as follows: First, it must produce a briquet capable of withstanding the shocks incident to heavy handling and shipping; second, it should be practically waterproof, so the briquets will not disintegrate on exposure to wet weather; third, it must maintain its binding qualities on heating so that the briquet will not fall to pieces in the fire; fourth, it should add to rather than detract from the fuel value of the briquet; fifth, it must be sufficiently cheap to warrant the marketing of the briquets in competition with other fuels.

The problem of briquetting mineral phosphates is by no means analogous to that of briquetting coal, because even after the phosphate is briquetted it is still in the nature of a raw material which must be treated at its source of supply before it can be converted into a marketable product. If the furnace process of producing phosphoric acid is to be employed in treating the run-of-mine phosphates of Florida and Tennessee, it is logical that the plant be located at or near the phosphate deposits. The handling of the briquetted charge, therefore, would be reduced to a minimum and there is little reason for making the briquets waterproof, since they would not have to be shipped or stored in the open. Moreover, inorganic binders which are considered so objectionable in making fuel briquets because of the extra ash which they add are permissible in the case of briquetting mineral phosphates provided they do not interfere with the chemical reactions involved in the furnace process. Finally, the fact that the use of briquets made from mine-run phosphates offers a promising means of eliminating what at present constitutes an enormous loss or waste of a valuable fertilizer asset and therefore the actual cost of briquetting might well exceed that of preparing high-grade phosphate rock for the market and still prove economical makes the problem distinctly different from that of briquetting coal, lignite or other fuel.

Experimental Work on Briquetting Florida Phosphates

The first experimental work was conducted with Florida phosphates from both the hard rock and land pebble fields, using a small hand press capable of making only a single briquet at a time under a pressure of a ton to the square inch. Various organic and inorganic binders were tried on mixtures of sand, coke and high-grade (washed) phosphate rock from these sources, but none of them proved very satisfactory either on account of their weak binding action or because of their prohibitive cost. It was found, however, that the clay-like material which occurs in many of the deposits inti-

[5] Waggaman and Turley, CHEM. & MET. ENG., vol. 23, p. 1057 (1920).

[6] Wright, C. L., Bull. 58, Bureau of Mines.

mately mixed with the phosphate rock acted as a very efficient binder when from 8 to 12 per cent of water was present in the final mix. Briquets were thus produced from run-of-mine phosphates (containing only natural binder) which proved so satisfactory in resisting severe shatter tests and in retaining their form unaltered during the preliminary heating in the furnace that large batches of material were made up and briquetted in roll presses of commercial size through the courtesy of the Lehigh Coal & Navigation Co., of Lanford, Pa., and the General Briquetting Co., of New York City. Briquets have thus been turned out in lots of several tons which were subsequently successfully treated in an oil-burning furnace at Arlington Farm, Va.[7]

Description of the Press Used

A number of mechanical and chemical problems arose, however, in connection with briquetting mineral phosphates and their subsequent use which it was deemed desirable to work upon, but in order to prepare the briquets for experimental purpose it was necessary to build a small briquetting machine which could also be depended upon to make up charges sufficiently large for treatment in a furnace of semi-commercial size. Accordingly the machine shown in Fig. 1 was built from an old cider press and may be briefly described as follows:

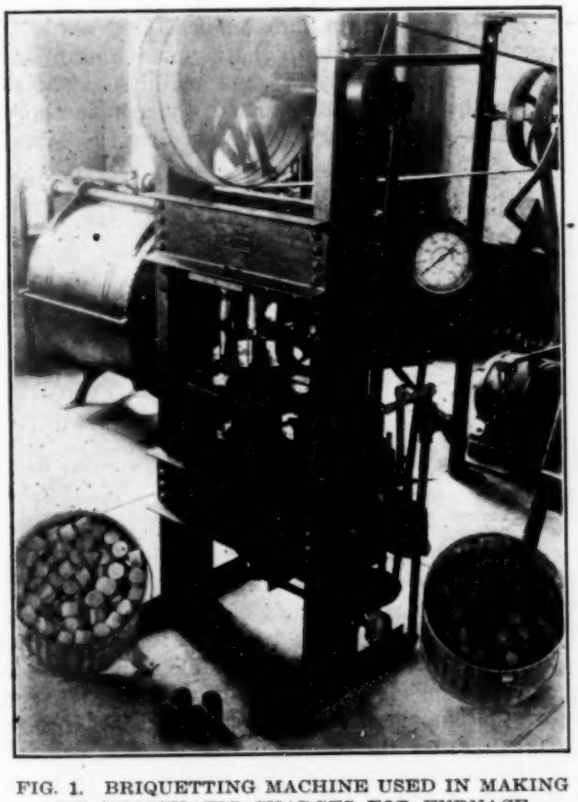


FIG. 1. BRIQUETTING MACHINE USED IN MAKING UP PHOSPHATIC CHARGES FOR FURNACE TREATMENT

Briquets of Florida phosphates on left and of Tennessee phosphates on right.

Four vertical steel plungers 2¾ in. in diameter are rigidly bolted to the upper part of the steel framework of the machine. These plungers are directly above two horizontal steel plates fitted one above the other and having four perforations in each corresponding in size to the plungers. The upper plate is held rigid and into its perforations are fitted four brass cylinders 3 in. in length which hold the mixture to be briquetted. By means of a lever the lower plate may be revolved so that the perforations therein will correspond to those in the upper plate and thus furnish a free passage for the plungers through each cylinder, or it may be so turned so as to close the bottom of the cylinders, forming a base upon which the briquets are pressed.

Both plates are mounted 3 in. above the bed plate of the press, which rests in turn upon the head of a 4-in. steel piston operating in a rigid sleeve. The necessary pressure is furnished by a small hydraulic pump operated by a 2-hp. motor.

To operate the press the piston is lowered by opening the valve controlling the water supply and permitting the water to flow back into its reservoir. The lower one of the two horizontal plates is then turned so as to form a base for the brass cylinders fitted into the perforations of the upper plate, and into these cylinders is loosely packed the mixture to be briquetted. The hydraulic pump is now started and raises the piston head carrying the brass cylinders filled with phosphate charge, pilot rods guiding these cups so that the four plungers are forced into them, pressing the mixture into briquets. When the pressure reaches 2,500 lb. to the square inch the valve controlling the pump is momentarily released, the lower plate revolved so as to open the bottom of the cylinders, the pressure again applied and the briquets forced out. In actual operation eight brass cylinders are provided, so that while four briquets are being made the supplementary cylinders are being filled.

Mechanical and Chemical Problems Involved in Briquetting Mineral Phosphates

The mechanical and chemical problems involved in the briquetting and use of mineral phosphates may be conveniently grouped as follows: (1) The mechanical composition of the material which best adapts it for briquetting purposes. (2) The chemical composition and its control. (3) The degree of fineness to which the mixture must be reduced to produce satisfactory briquets. (4) Methods of incorporating into the mixture the water necessary for imparting to the natural binder its cementing qualities. (5) The best proportion of water to use for this purpose. (6) The effect of reducing agents upon the briquets.

A number of experiments conducted with samples of mine-run phosphates from the Florida fields showed that satisfactory briquets could be made from mixtures of phosphate rock, sand and coke if the percentage of material classed as clay (according to the system of mechanical analysis employed in the Bureau of Soils[8]) was equal to or exceeded 20 per cent of the entire mass.

Experimental Work in Briquetting Tennessee Phosphates

It seemed desirable to ascertain if the briquetting process which proved successful with Florida phosphates could also be applied to the Tennessee phosphates, particularly to those deposits which require elaborate plants to prepare a product suitable for the fertilizer industry. Moreover, many of the deposits in the brown rock phosphate fields of Tennessee from

[7]Waggaman and Turley, CHEM. & MET. ENG., vol. 23, p. 1057 (1920).

[8]Bull. 84, Bureau of Soils (1912).

TABLE I. LOCATION, DESCRIPTION AND MECHANICAL ANALYSES* OF PHOSPHATES USED IN BRIQUETTING EXPERIMENTS

Sample No.	Location	Thickness of Stratum	Description	Mechanical Analysis, per Cent: Fine Gravel, 2–1 Mm.	Coarse Sand, 1–0.5 Mm.	Medium Sand, 0.5–0.25 Mm.	Fine Sand, 0.25–0.10 Mm.	Very Fine Sand, 0.10–0.05 Mm.	Silt, 0.05–0.005 Mm.	Clay, 0.005–0.0000 Mm.
1-T	Consolidated Phos. Co., Hickman Co., Tenn.	6 ft. 0 in.	Brown phos. containing lump rock	6.1	9.7	5.1	39.0	13.4	14.6	12.1
3-T	Deposit near Gallatin, Summer Co., Tenn.	4 ft. 0 in.	Brown disintegrated phosphate	5.4	6.3	2.4	20.5	19.4	18.3	27.6
4-T	Deposit near Gallatin, Summer Co., Tenn.	4 ft. 0 in.	Similar to No. 3-T	6.5	5.3	2.1	17.4	24.1	17.6	27.0
5-T	Deposit near Gallatin, Summer Co., Tenn.	2 ft.+	Muck overlying Nos. 3-T and 4-T	5.1	5.9	2.3	19.4	18.9	19.1	29.4
6-T	Ruhm Phos. Co., Mt. Pleasant, Maury Co., Tenn.	5 ft. 0 in.	Brown phos. containing lump rock	3.9	8.5	8.4	35.5	9.6	16.1	17.7
7-T	Ruhm Phos. Co., Mt. Pleasant, Maury Co., Tenn.	7 ft. 0 in.	Brown phos. containing lump rock	3.3	9.3	5.0	31.3	10.0	16.8	24.2
8-T	Ruhm Phos. Co., Mt. Pleasant, Maury Co., Tenn.	14 ft. 0 in.	Sample from upper end of waste pond	0.1	0.5	0.7	22.2	18.8	39.0	18.5
9-T	Ruhm Phos. Co., Mt. Pleasant, Maury Co., Tenn.	15 ft. 0 in.	Sample taken 63 ft. from 8-T	0.0	0.0	0.2	7.7	16.3	50.2	25.6
10-T	Ruhm Phos. Co., Mt. Pleasant, Maury Co., Tenn.	10 ft. 3 in.	Sample taken 63 ft. from 9-T	0.0	0.2	0.2	11.8	18.2	45.8	23.8
11-T	Ruhm Phos. Co., Mt. Pleasant, Maury Co., Tenn.	5 ft. 11 in.	Sample taken 63 ft. from 10-T	0.0	0.1	0.0	1.7	9.8	56.7	31.7
12-T	Ruhm Phos. Co., Mt. Pleasant, Maury Co., Tenn.	5 ft. 0 in.	Sample taken 63 ft. from 11-T	0.0	0.0	0.1	13.4	11.0	41.1	34.4
13-T	Ruhm Phos. Co., Mt. Pleasant, Maury Co., Tenn.	4 ft. 6 in.	Sample taken 63 ft. from 12-T	0.0	0.0	0.1	2.3	4.8	44.0	48.8
14-T	Charleston, S. C., Mining Co., Wales, Giles Co., Tenn.	10 to 20 ft.	Brown disintegrated phosphate	3.6	9.5	5.6	23.7	7.8	20.4	29.2
15-T	Int. Agric. Corp., Wales, Giles Co., Tenn.	10 to 20 ft.	High-grade disintegrated phosphate	2.6	7.5	5.1	26.8	9.3	18.4	30.0
16-T	Int. Agric. Corp., Wales, Giles Co., Tenn.	10 to 20 ft.	Low-grade disintegrated phosphate	0.8	2.4	1.4	41.1	7.9	13.8	32.5
17-T	Federal Chemical Co., Ridley Mines, Maury Co., Tenn.	15 ft. +	Sample phos. sand from waste pond	0.0	1.6	2.3	37.9	28.3	17.8	11.9
18-T	Federal Chemical Co., Ridley Mines, Maury Co., Tenn.	6 to 10 ft.	Mine-run brown phosphate	3.4	7.8	4.5	22.2	8.6	19.7	33.8
19-T	Federal Chemical Co., Ridley Mines, Maury Co., Tenn.	6 to 10 ft.	Mine-run brown phosphate	5.5	11.2	6.5	29.7	9.4	16.6	21.0
20-T	Federal Chemical Co., Ridley Mines, Maury Co., Tenn.	6 to 10 ft.	Mine-run brown phosphate	3.4	8.8	5.3	25.6	9.4	22.4	25.0
1-F	Downing Phos. Co., Bartow, Polk Co., Florida	.....	Mine-run phosphate	4.8	12.1	6.9	26.5	5.8	7.6	36.2

* Mechanical analyses made according to the conventional method employed in classifying soil types in the Bureau of Soils.

which the high-grade lump rock has been removed are now being reworked and much valuable material recovered. There are also immense beds of disintegrated phosphate rock in the southern part of this state which are frequently so high in silica that it is uneconomical to mine them. The senior author made a trip to these fields early in the year to examine the nature of many of these deposits and to determine if it were possible to briquet the mine-run phosphates and utilize them in the furnace process. Average samples of from 200 to 250 lb. each were taken from the various deposits and both mechanical and chemical analyses were made. Most of the experiments described below were conducted with samples from the Tennessee fields.

In Table I is given the mechanical analysis of the phosphates on which briquetting experiments were conducted.

Inspection of Table I will show that as far as their mechanical composition is concerned all of the samples of phosphate, with the exception of Nos. 1-T, 6-T, 8-T and 17-T, contained sufficient material classified as clay to bind them into satisfactory briquets. But the ultimate mechanical composition of the mix depends also upon the amount of sand or rock which must be added to obtain the proper silica lime ratio in the furnace charge, therefore the fitness of these mine-run phosphates for briquetting purposes and subsequent furnace treatment must be determined by their chemical composition.

In Table II are given the chemical analyses of the same samples, together with the ratio of lime to silica therein. The quantities of sand or high-grade rock which must be added to 100 parts of the sample in order to obtain the proper relation between lime and silica to bring about the reaction involved in the volatilization process are also shown in this table.

TABLE II. CHEMICAL ANALYSIS AND SILICA-LIME RELATIONS OF NATURAL PHOSPHATES

Sample No.	Chemical Analysis: SiO_2	CaO	P_2O_5	Fe_2O_3	Al_2O_3	Total	Ratio SiO_2:CaO	Material Necessary to Give Ratio SiO_2:CaO = 59.0:41.0 = 1.439: To 100 Pts. of Phos. Sample, Sand	Rock*
1-T	10.00	42.66	31.86	3.26	3.90	91.68	0.232	51.35	....
3-T	30.23	28.17	22.03	4.06	6.94	91.43	1.073	10.27	....
4-T	38.74	23.00	17.88	4.45	5.00	89.07	1.686	.....	8.20
5-T	24.39	31.15	24.10	4.10	6.50	90.24	0.783	20.41	....
6-T	15.53	38.32	27.68	3.56	4.33	89.42	0.405	39.65	....
7-T	18.69	33.09	25.20	4.84	5.54	87.36	0.565	28.91	....
8-T	49.60	18.24	14.21	3.76	4.73	90.54	2.717	.....	33.9
9-T	58.94	12.20	10.23	4.30	5.06	90.73	4.830	.....	60.1
10-T	56.32	15.16	12.05	3.98	4.41	91.92	3.716	.....	50.0
11-T	66.81	8.05	6.92	4.46	6.82	93.06	8.300	.....	80.0
12-T	55.68	12.58	10.51	4.78	7.85	91.40	4.430	.....	54.5
13-T	61.18	6.60	6.32	5.68	9.57	89.34	9.275	.....	74.8
14-T	23.42	30.78	22.70	5.22	7.40	89.52	0.762	20.85	....
15-T	22.26	31.41	23.85	4.78	7.79	90.09	0.708	22.94	....
16-T	57.34	12.00	11.23	4.90	7.23	92.70	4.775	.....	58.0
17-T	21.85	35.61	26.01	2.93	4.75	91.15	0.613	29.43	....
18-T	23.86	30.26	22.76	4.55	8.40	89.83	0.788	19.64	....
19-T	16.50	37.41	25.84	3.02	5.50	88.27	0.441	37.33	....
20-T	28.90	28.64	20.79	3.82	6.63	88.78	1.070	12.31	....
1-F	26.96	29.05	23.61	2.09	8.40	90.11	0.928	14.85	....

* The rock used in reinforcing the lower grades of phosphate was an average grade of pebble phosphate from the Florida fields.

TABLE III. BRIQUETS FORMED BY MIXTURES OF NATURAL PHOSPHATE ROCK, SAND AND COKE

Sample No.	Briquet Mixture (SiO_2 : CaO :: 59.00 : 41.00): Rock Sample, G.	Sand, G.	Coke, G.	Calculated Composition of Briquet Mixture (Air Dried): SiO_2	CaO	P_2O_5	Fe_2O_3	Al_2O_3	Coke*
3-T	100	10.27	15.05	32.31	22.47	17.60	3.24	5.54	12.00
5-T	100	20.41	16.40	32.80	22.80	17.62	3.00	4.75	12.00
7-T	100	28.91	17.55	32.70	22.59	17.20	3.31	3.78	12.00
14-T	100	20.85	16.47	32.25	22.40	16.54	3.80	5.39	12.00
15-T	100	22.94	16.75	32.35	22.50	17.09	3.42	5.58	12.00
18-T	100	19.64	16.30	32.00	22.23	16.75	3.35	6.18	12.00
1-F	100	14.85	15.65	32.10	22.25	18.10	1.60	6.44	12.00

* The fixed carbon plus ash considered as coke. The coke used in these experiments contains 14.9% of ash. An analysis of this ash showed that the coke in the briquetted mixture adds 0.98% SiO_2, 0.02% CaO, and 0.63% Al_2O_3, Fe_2O_3, to the mix.

The phosphoric acid content of Nos. 8-T, 9-T, 10-T, 12-T, 13-T and 16-T are so low as to eliminate these samples as commercial possibilities unless they are reinforced with a considerably higher grade phosphate rock. Most of the samples low in phosphoric acid, however, were taken from the waste ponds of old phosphate plants and represent the detritus washed out from run-of-mine material in preparing a high-grade rock for the market. It will also be noticed that in almost every instance these lower grade phosphates contain a high proportion of both the clay-like binding material and silica and hence offer a promising source of material to mix with higher grade phosphates low in these two ingredients.

In Table III are given the quantities of sand, coke and better grades of mine-run phosphate used in making up the briquetted charge. The composition of the briquetted mixture (air dried), is also given in the same table.

In the cases of Nos. 14-T and 18-T the percentage of

phosphoric acid in the briquetted charge was somewhat lower than in the other mixtures. This is no doubt due to the fact that in addition to the lime combined with phosphoric acid a part of this base present in the original phosphate samples was in the form of carbonate and therefore the sand added to take care of the lime in this latter compound reduced the percentage of phosphoric acid in the briquets.

In Table IV the same data are given for mixtures of two or more samples of phosphate and the figures show how deposits of low-grade phosphate may be utilized by mixing the material with that from adjacent or nearby deposits of higher grade.

TABLE IV. BRIQUETS FORMED BY MIXTURES OF HIGH-GRADE AND LOW-GRADE PHOSPHATE ROCK WITH COKE

Sample No.	Briquet Mixture — SiO_2 : CaO :: 59.00 : 41.00 Rock Sample, G.	Sand, G.	Coke, G.	Calculated Composition of Briquet Mixture (Air Dried) SiO_2	CaO	P_2O_5	Fe_2O_3	Al_2O_3	Coke*
3-T	35.48	.....	13.63	31.42	20.92	17.00	3.80	5.00	12.00
4-T	64.52								
7-T	44.7	.....	13.63	31.50	21.90	16.83	3.74	4.49	12.00
8-T	55.3								
15-T	63.6	.....	13.63	30.80	21.45	16.95	4.25	6.68	12.00
16-T	36.4								
18-T	33.33	23.10	16.79	33.00	22.95	16.55	4.89	6.37	12.00
19-T	33.33								
20-T	33.33								

* The fixed carbon plus ash considered as coke. The coke used in these experiments contains 14.9 per cent of ash. An analysis of this ash showed that the coke in the briquetted mixture adds 0.98 per cent SiO_2, 0.02 per cent CaO and 0.63 per cent Al_2O_3, Fe_2O_3 to the mix.

In preparing the materials for briquetting purposes they were first dried down to a point where they contained approximately from 2 to 4 per cent of moisture. They were then ground in a small grist mill and passed through a sieve having fifteen meshes to the linear inch. Although some preliminary experiments indicated that finer grinding imparted somewhat greater resisting power to the briquets, the difference between the durability of the briquets produced from the materials of these different degrees of fineness was not sufficiently great to warrant the additional expense involved.

One of the problems encountered in preparing the ground material for briquetting purposes is to find a satisfactory method of introducing the necessary water to give the mass its binding qualities. At least 10 per cent of water must be contained in the mixture before satisfactory briquets can be produced, and if this water is merely poured or sprinkled upon the material the clay contained therein has a tendency to ball up and prevent the uniform distribution of the moisture. Introducing the water, however, by means of sprays or atomizers while constantly turning the mass gave a very uniform distribution and prevented the formation of clay balls. It was also found that if a basin-like depression were made in the pile of the charge to be briquetted and the necessary water poured into this basin and covered with dry material, at the end of eighteen or twenty hours the mass was in a fairly friable condition which admitted of thorough mixing.

The most satisfactory method of introducing the necessary moisture, however, particularly where the phosphate requires the addition of both sand and coke, is to mix the water with this sand and coke and then add these two ingredients to the phosphate mineral. This procedure seems to eliminate the difficulty encountered in the balling up of the clay contained in the mass.

In Table V the results obtained on briquetted charges of relatively high-grade phosphate, sand and coke are given. These briquets were made up with varying percentages of moisture and the shatter and compression tests were applied not only to the fresh briquets but to the air-dried and oven-dried samples as well.

With the exception of Nos. 3-T, 7-T and 1-F all of the briquets in the air-dried condition withstood a drop on a cement floor of from 6 to 8 ft. and a drop of 20 ft. or more upon a mass of other briquets. The drying of the briquets in an oven increased considerably the effectiveness of the binder, but in actual commercial practices it would scarcely be economically feasible to dry the briquets in this way. In furnace practice, however, the briquets would never be subjected to a drop of over 15 ft. upon a mass of similar briquets, and therefore for practical purposes they would meet all requirements.

TABLE V. SHATTER TESTS ON BRIQUETS MADE FROM NATURAL PHOSPHATE ROCK, SAND AND COKE

Sample No.	Fresh Briquets — Weight, G.	H_2O Per Cent	Shattered on Dropping to Cement Floor Ft.	Air-Dried Briquets* — Shattered on Dropping to Cement Floor Ft.	Withstood Drop on Mass of Similar Briquets, Ft.	Compression Test, Lb./sq.-In.	Oven-Dried Briquets — Shattered on Dropping to Cement Floor Ft.	Withstood Drop on Mass of Similar Briquets, Ft.
3-T	133.5	8.69	4	5	18	472.0	9	20
3-T	124.7	11.15	8	6	20	800.0	10	20
3-T	115.2	13.63	14	7	20	838.0	12	20
5-T	113.7	11.08	8	7	20	483.0	11	20
5-T	126.4	13.13	12	8	20	654.0	12	20
7-T	122.1	10.49	..	5	..	.....	7	20
7-T	105.2	9.50	8	6	15	815.0	9	20
7-T	116.4	13.14	10	7	16	950.0	12	15
14-T	131.3	9.99	9	6	18	724.0	9	20
14-T	120.9	10.47	12	6	18	793.0	10	20
15-T	121.7	9.53	6	8	20	407.0	11	20
15-T	119.2	12.35	20	7	20	894.0	13	20
15-T	115.7	12.62	12	11	20	538.0	10	20
18-T	120.6	13.27	20+	8	20	887.0	13	20
1-F	107.0	11.21	5	4	..	.....	6	14
1-F	105.5	13.53	10	5	..	.....	9	16
1-F	108.7	13.45	20+	..	..	.....	8	20

* Average weight = 109.0 g. Average H_2O content = 2.95%

TABLE VI. SHATTER TESTS ON BRIQUETS MADE FROM MIXTURES OF LOW- AND HIGH-GRADE PHOSPHATE ROCK WITH COKE

Sample No.	Fresh Briquets — Weight, G.	H_2O, Per Cent	Shattered on Dropping to Cement Floor, Ft.	Air-Dried Briquets — Shattered on Dropping to Cement Floor, Ft.	Withstood Drop on Mass of Similar Briquets, Ft.	Compression Test, Lb./Sq. In.	Oven-Dried Briquets — Shattered on Dropping to Cement Floor, Ft.	Withstood Drop on Mass of Similar Briquets, Ft.
3-T	118.5	12.00	12	12	18	728.0	14	20
4-T								
7-T	113.5	11.90	8	8	20	738.0	8	20
8-T								
7-T	103.0	14.30	10	10	20	960.0	10	20
8-T								
15-T	111.6	14.35	20+	10	20	1,004.0	18	20
16-T								
18-T								
19-T	121.6	11.02	9	8	15	811.0	11	20
20-T								

In Table VI the same tests are given on briquets made up of two or more samples of phosphate rock, and it will be noted that these briquets were even more satisfactory than those given in Table V. The figures given in these tables seem to show that the moisture content required for the successful briquetting of the mixtures employed range from 8½ to 14 per cent, but on the whole briquets of a very satisfactory nature can be obtained where the average moisture content is between 10 and 12 per cent.

In order to determine the effect of high heat upon the briquetted samples a number of freshly made briquets with their full percentage of moisture were placed in a muffle furnace heated to bright redness (1,000 deg. C.). These briquets showed no signs of splitting or disinte-

grating when submitted to this severe test, but shatter tests subsequently conducted with them indicated that the internal stress set up by the rapid elimination of moisture weakened them to a slight extent. In no instance, however, was this weakness sufficiently pronounced to render them unfit for furnace use.

Bituminous Coal and Peat as Reducing Agents

Because of the difficulty of grinding coke, its abrasive action on milling machinery and the difficulty of obtaining an adequate supply at a low price in those phosphate fields far removed from the coke ovens or municipal gas plants, a number of experiments were made to determine if bituminous coal or peat might be employed as the reducing agent in the briquetted charge.[1] It was feared that the high percentage of volatile matter in these materials would cause the briquets to split open at the temperatures attained in the furnace, particularly if sufficient amounts were added to give the same quantity of fixed carbon supplied by the coke. Moreover, it seemed likely that in order to burn completely the extra amount of combustible gas evolved from such briquets in actual furnace practice so much air must be drawn into the system that the efficiency of the towers for collecting or absorbing the phosphoric acid would be considerably reduced.

The briquets made up with these two reducing agents stood up very well under the shatter test employed, though those containing peat were rather light and somewhat weaker than the coal and coke briquets.

By referring to Table VII it will be noted that where bituminous coal was employed as a reducing agent the amount used in making up the briquets supplied only

TABLE VII. APPROXIMATE ANALYSIS OF COKE, BITUMINOUS COAL AND PEAT, QUANTITIES USED IN BRIQUETTED CHARGE AND AMOUNT OF FIXED CARBON CONTAINED IN BRIQUETS BEFORE AND AFTER HEATING

Material	Approximate Analyses, Per Cent: Moisture	Volatile Matter	Fixed Carbon	Ash	Amount Added to Briquetted Charge, Per Cent	Amount of Fixed Carbon in Briquets: Dried Briquet, Per Cent	Briquet Heated to 1,000 Deg. C., Per Cent
Coke.....	0.38	0.84	84.59	14.19	12.00	10.40	9.61
Bituminous Coal	4.15	35.72	48.15	11.99	18.50	9.16	11.73
Peat.....	10.97	52.93	30.30	5.80	19.37	6.10	4.83

88.0 per cent as much fixed carbon as was furnished by the coke and where peat was used it was added in quantities supplying only 58.7 per cent as much fixed carbon as was furnished by the coke.

The coal and peat briquets made up in this manner when ignited in a muffle furnace at 1,000 deg. C. soon burst into flame, but did not split open or disintegrate as expected, although the latter briquets subsequently showed considerable porosity. The same thing held true when the briquets were placed in a forge fire, except in the latter case a glaze or slag formed over their surfaces, protecting more efficiently the carbon in the interior from oxidation.

Upon breaking open the briquets subjected to this treatment, the carbon content of those made up with bituminous coal was found so uniformly distributed throughout the mass and apparently in so much larger quantities than in the coke briquets submitted to the same treatment that it seemed probable that some of

[1] Peat is available in large quantities close to the Florida phosphate fields, and bituminous coal from Kentucky is the chief fuel used by the Tennessee phosphate operators.

FIG. 2. SAMPLES OF BRIQUETS (AFTER HEATING IN MUFFLE AND FORGE FIRE) MADE FROM TENNESSEE MINE-RUN PHOSPHATES MIXED WITH VARIOUS REDUCING AGENTS

Note the distribution of carbon in those made up with coal and peat (two piles to right) as compared with those in which coke was used (pile to left of center).

the volatile hydrocarbons had decomposed within the briquets and deposited their carbon content. The difference in the appearance of the briquets made up with coke, coal and peat is shown in Fig. 2.

Analyses of the ignited briquets bore out this assumption, since the actual fixed carbon found in those made up with coal was higher after ignition than before and surpassed the fixed carbon content of the briquets made up with coke. The approximate analyses of the reducing agents used, the quantities added and the fixed carbon content of the briquets before and after ignition are given in Table VII.

The fixed carbon content of the ignited coal briquets shows that over 35 per cent of the volatile matter was retained within the mass as precipitated carbon, but those briquets in which peat was used actually showed a loss of fixed carbon due probably to the fibrous nature of the peat and the consequent porosity of the briquets in which this reducing agent was used.

The deposition of carbon through the mass of finely divided minerals in the coal briquets should insure quicker and more complete reactions between the ingredients in the furnace charge and make it possible to reduce the percentage of coal used at least 18 per cent below that which was first deemed necessary.

While the results obtained with peat as a reducing agent were not as promising as those obtained when coal was employed, the indications are that the former may be used to replace at least part of the coke or coal required. It is realized that the final proof of the effectiveness of these materials in lieu of coke and the practicability of using them in the volatilization process of producing phosphoric acid must rest in the actual furnace tests which are now being planned; nevertheless the results obtained with coal are very encouraging and give promise of further reducing the cost of preparing the phosphatic charge for subsequent furnace treatment.

Chinese Vegetable-Tallow Industry

Exports of vegetable tallow from China total annually about 200,000 piculs (1 picul = 133⅓ lb.), most of which, before the war, was sent to the Netherlands, France and Germany. Now, however, the United States, Italy and Great Britain have become the chief buyers. The following figures quoted from the Chinese Maritime Customes show the exports of the commodity in China's trade from 1914 to 1920, in piculs: 1914, 190,094; 1915, 181,482; 1916, 256,960; 1917, 151,385; 1918, 162,881; 1919, 164,544; 1920, 69,118.

Eliminating Blow-Holes in Thermit Welds

A NEW grade of molding material for Thermit welding has recently been developed by the Metal & Thermit Corporation, New York, which, as proved, will definitely prevent blow-holes and assure sound welds.

The design of the new molding material, designated as "Thermit Molding Material," is based on the theory that good silica sand will stand the heat of the Thermit reaction very well and that the weakness in all molding material is the clay binder. Therefore there should be as little clay as possible in the mixture, in order to make the mold more refractory and to increase its porosity. Plastic clay has been selected instead of a fireclay. The sand and plastic clay are ground together in a foundry pan or moller, with the intention of coating each grain of sand with a minimum thickness of clay. This gives a good, clean molding material, which should be rammed hard in the mold, which will stand up well under the pre-heating flame and which is extremely porous to the gases generated in the mold, resulting in a sound weld with a very clean exterior.

The Mixture Used

The mixture now being used is composed of the following: Three parts clean, sharp silica sand (100 per cent of which should pass through a screen having a 0.03-in. square opening, and 40 per cent of which should be retained on a screen having a 0.012-in. square opening), mixed with 1 part Welsh Mountain plastic clay. These parts are first thoroughly mixed in the moller together with one-fortieth part glutrin by volume and sufficient water (one-twelfth part) to bring to the proper consistency. If mixed by hand, the sand and clay must be dried before mixing (being careful not to subject the clay to a temperature higher than 400 deg. F.) and thoroughly mixed before adding the glutrin and water. The glutrin should be mixed with the water before adding to the sand and clay.

In case a plastic clay fatter than the Welsh Mountain be used, the mixing, of course, will have to be more thorough and less clay used. Welsh Mountain clay is being used in the present mixture because in carefully run tests it has proved to be the most refractory. The use of the new molding material necessitates harder packing next to the weld; in fact, the regular Thermit rammer may be supplemented by the use, for instance, of a tool having an end ⅜ x 1½ in., so that the operator may be able to peen the sand next to the wax collar and the various patterns.

Precautions That Are Essential

It is absolutely essential, in the production of sound welds, to be sure that no loose sand exists in the mold when the Thermit steel is poured. This is why very hard ramming is advocated, also why it is most important to blow out all loose material from the interior of the mold by putting the pre-heating burner in the riser before the heating gate is plugged and being sure that no sand is detached by the operation of inserting this heating gate. The burner should be removed from the riser before plugging the heating gate, because otherwise it may detach some sand, which could not be blown out after the plug is in place. The heating gate plug should be thoroughly dry, and if it has been carried in stock for some time, it should be warmed before using.

By perforating the sides and bottom of the mold box, the escape of the gases which pass through the molding material is greatly facilitated; ⅜-in. diameter holes, spread 3 or 4 in. apart, are sufficient. To facilitate the escape of gas from the bottom of the mold box, the mold should rest on blocks, not directly upon the foundry floor.

As unnecessary molding material simply increases the resistance to the passage of gas, the mold box should be made as small as possible commensurate with safety. For example, in welding a 4 x 4-in. section, only about 4 in. of sand is necessary at all points, except perhaps on the pouring gate side. It is most important thoroughly to vent the mold box by forcing a rod or wire down at a number of points to within ½ in. or so of the collar. Care should be taken that these do not touch the collar, because such vent holes will fill with steel and will therefore not facilitate the escape of gas.

Recent Chemical & Metallurgical Patents

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

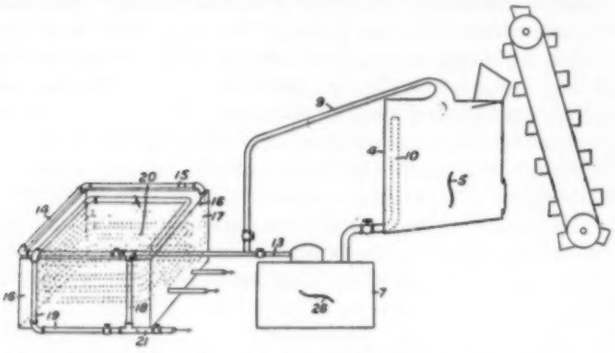
Alkaline Earth Chlorides.—Calcium, magnesium and other alkaline earth metal chlorides in anhydrous condition suitable for electrolysis are obtained by adding ammonium chloride and the oxide, hydrate, carbonate or oxychloride of the alkaline earth metal to a melt of one or more haloid salts of a metal electropositive to the alkaline earth metals, such as a mixture of sodium and potassium chlorides, and collecting the ammonia or ammonium carbonate evolved. The ammonium chloride may be 10 to 20 per cent in excess of the theoretical quantity. The ammonia or ammonium carbonate is converted into ammonium chloride for re-use by combining it with hydrochloric acid obtained by passing a mixture of chlorine and steam over carbon heated to 300 deg. C. (Br. Pat. 163,304; not yet accepted. Minami Manshu Tetsudo Kabushiki Kaisha, assignees of I. Namari, Osaka Fu, Japan; July 6, 1921.

Extracting and Separating Metals.—The production of one salt from a mixture of oxides such as that obtained by roasting a sulphide ore is effected by submitting the mixture to the action of a gaseous acid radical under such temperature and with such pressure of the acid radical as will effect the preferential reaction desired. The invention is described in connection with the treatment of a mixture of copper and iron oxides obtained by roasting copper pyrites. This mixture is heated with sulphur trioxide under the necessary conditions at a temperature of about 620-700 deg. C., when copper sulphate alone forms. The invention is applicable to the formation of other salts such as chlorides, and to the treatment of various mixtures of oxides. The separation of copper and nickel and the extraction of aluminum salts from bauxite or other materials are mentioned. In a similar manner a mixture of salts of the same acid radical may be treated in order to effect the decomposition of one but not of the other. (Br. Pat. 163,348. W. J. Niiranen, Helsingfors, Finland, and A. Hibbert, Bexhill, Sussex; July 6, 1921.)

Casein Cements.—Powdered glue or gelatine is incorporated with the normal constituents of a casein cement in powder form. A material such as an alkali salicylate,

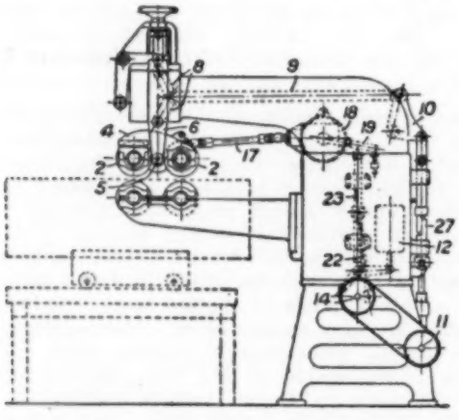
benzene or naphthalene sulphonate, may be added to facilitate the solution of the glue in cold water. An example is given of a powdered cement containing casein, lime, gelatine or glue, sodium fluoride and sodium naphthalene sulphonate. (Br. Pat. 163,349. P. H. W. Serle, London; July 6, 1921.)

Distilling Waste Grease.—Waste roll or axle grease or pitch obtained from steel-works, tin-plate rolling mills, etc., is distilled to obtain oils and greases, and, in some cases, a residue of coke. The waste grease is melted in a primary



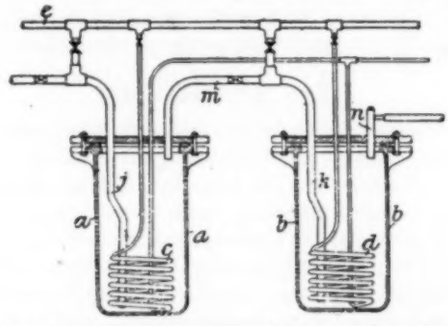
still 4, from which the vapors are led by a pipe 9 to a condenser. The melted grease is drawn off by a perforated pipe 10 to a main still 7. The vapors pass to a condenser in which, by means of cocks, alternative passages may be opened. The light vapors are passed through pipes 18, 19 and a coil 20 immersed in a cooling tank 16. The middle vapors are passed through pipes 14, 15 and a pipe 17 in the cooling tank and the heavy vapors through pipe 18 and an exit pipe 21. A tank containing a freezing mixture may be used to condense very light vapors. Air may be injected into pipe 13 to assist in condensing the heavy vapors. Stirrers 5, 26 are provided in the stills 4, 7. The liquid residue from the still 7 may be distilled in a separate still to form coke. (Br. Pat. 163,056. L. Lane and D. H. Williams, both in Glamorgan; July 6, 1921.)

Electric Welding.—Thick metal plates or sheets, etc., are electrically welded by two pairs of intermittently rotated roll or wheel electrodes, current being on only when they are stationary. The work may be fed between the electrodes, or the electrodes traversed over the work. The pairs of electrodes may be arranged in tandem so that the parts left unwelded by one pair are welded by the second pair or they may be arranged so that the axes of the upper electrodes and also those of the lower electrodes are coincident, the two



lower electrodes in this case being practically in one. In the former case the shafts may be spaced well apart or may be close together so that the welds partly overlap. The upper electrodes are connected to the terminals of the transformer secondary, and the lower electrodes are electrically connected together. In the tandem arrangement shown, the upper electrodes 2 are mounted in a carrier 4 pivoted at 5 to the slide 6 so that they always bear evenly on the work. The slide is operated by a toggle 8, rod 9, bell-crank 10 and rods 27 from the shaft 11. The electrodes are rotated intermittently by spur and worm gear through a shaft 17, which is rotated by gearing through a ratchet wheel 18 operated by a pawl lever 19 from a crank-shaft 14 through rods 22, 23. The current is put on when the electrodes are stationary by a switch 12, operated by a cam on the shaft 14, which is driven by a belt from the shaft 11. The electrodes are further pressed down when the welds are made to put the welds under pressure. (Br. Pat. 163,083. British Insulated & Helsby, Charles Ltd., and L. B. Wilson, Prescot, Lancashire; July 6, 1921.)

Converting Oils and Fats Into Triglycerides.—Fatty acids, or oils or fats containing free fatty acids, are converted into triglycerides by heating with glycerine to a temperature of 200-250 deg. C., whereby the glycerine reacts in the vapor state. According to one method of procedure, the glycerine contained in a still *a* is carried over by superheated steam into a vessel *b* containing the fatty acid or oil or fat containing free fatty acid, the superheated steam being admitted to the vessels *a*, *b* by pipes *j*, *k* connected with the main pipe *e*. Both vessels are provided with heating coils *c*, *d* and are subjected through pipes *m*, *n* to the action of a vacuum pump. In an alternative method, the glycerine is introduced in the liquid form into the bottom of a still containing the fatty acid material heated to the requisite temperature; in this case, an addition of 2 per cent of water



to the glycerine favors its vaporization. Any known catalyst may be employed, together with means for agitating the material. Mono- and di-glycerides can be produced by combination with the requisite amount of glycerine vapor. (Br. Pat. 163,352. E. R. Bolton and E. J. Lush, both of London; July 6, 1921.)

Ammonium Salts.—Residual liquor from the ammonia-soda process containing principally ammonium chloride and carbonate and sodium chloride is heated to near its boiling point until all the ammonium carbonate and free carbon dioxide are evolved. The ammonium carbonate or mixture of carbonate and bicarbonate is collected in the solid condition; preferably carbon dioxide is introduced if necessary so that all the ammonium is in the form of bicarbonate. The liquor is concentrated to one-third to two-thirds its volume and cooled to below 25 deg. C., when technically pure ammonium chloride crystals are obtained. After filtration, the mother liquor is again concentrated at its boiling point to one-third to two-thirds its volume, in order to separate sodium chloride. The latter is removed as nearly as possible at 110 deg. C., the boiling point of the solution. The liquor now contains ammonium chloride and sodium chloride in approximately the same proportion as the original solution and may be treated as above described, but preferably fresh residual liquor is first added. The ammonium chloride contains only small quantities of sodium chloride and is suitable as a manure, but it may, however, be purified by recrystallization or sublimation. (Br. Pat. 164,001; not yet accepted. Elektrizitätswerk Lonza, Basel, Switzerland; July 20, 1921.)

Soluble Silicates.—Soluble silicates of high silica content are prepared by dissolving silicic acid in alkali silicate solutions obtained by fusing silica and alkali, or silica, alkali and borax, and treating the cooled and broken melt with water. The silicic acid is prepared, for example, by adding sulphuric acid to cold water-glass solution and after dialysis is dissolved in the silicate solution, by continued grinding or agitation. (Br. Pat. 163,877. F. J. Phillips, London; July 20, 1921.)

Current Events
in the Chemical and Metallurgical Industries

Special Duties Continued on Coal-Tar Products and Dyes

Title V of the Act of Sept. 8, 1916, entitled "An act to increase revenue and for other purposes," imposing duties on dyes and other chemical coal-tar products, contains the following provision in section 501:

> During the period of five years beginning five years after the passage of this act such special duties shall be annually reduced by 20 per centum of the rate imposed by this section, so that at the end of such period such special duties shall no longer be assessed, levied or collected; but if, at the expiration of five years from the date of the passage of this act, the President finds that there is not being manufactured or produced within the United States as much as 60 per centum in value of the domestic consumption of the articles mentioned in Groups II and III of section 500, he shall by proclamation so declare, whereupon the special duties imposed by this section on such articles shall no longer be assessed, levied or collected.

As a result of the coal-tar censuses taken by the Tariff Commission, the commission was able to report to the President that the domestic production of the articles enumerated in Groups II and III is much in excess of 60 per cent of the domestic consumption. The facts, therefore, do not call for the issuance of a proclamation removing the specific duties under section 501 of the act cited above.

Government to Study Helium Production

An engineering study of the whole subject of helium recovery at the Petrolia plant is to be made by a board of engineers which has been named by Director Bain of the U. S. Bureau of Mines with the approval of the Army and Navy Helium Board. M. H. Roberts, formerly chief engineer of the Air Reduction Co., is chairman of the board of engineers. The other members are R. C. Tolman, head of the Fixed Nitrogen Laboratory of the Department of Agriculture, and Prof. W. L. DeBaufre of the University of Nebraska, formerly an instructor at the U. S. Naval Academy.

The large-scale operations at Petrolia, Tex., have been discontinued due to the reduction made by Congress in the appropriation for this work. It is the intention to continue the study on a small scale along the lines which will be designated by the new board of engineers.

In the fiscal year ended June 30, 1921, the Army transferred $545,200 to the Bureau of Mines for helium work. During the same period, the Navy transferred $207,500 to the Bureau of Mines for the same purpose. The allocation of the fund was as follows: operation and maintenance of helium plant No. 3, at Petrolia, Tex., $425,000; equipment of cryogenic laboratory, at Washington, D. C., $15,000; operation and maintenance of cryogenic laboratory, $61,000; helium laboratory, Fort Worth, Tex., $18,000; helium storage, Pittsburgh, Pa., $1,000; railroad repurification unit, Washington, D. C., $25,000; helium repurification plant, Langley Field, Va., $42,700; helium gas leasing fund, $150,000; co-operative work at Massachusetts Institute of Technology, $3,000; co-operative work at Harvard University, $2,000, and for other helium work, $10,000.

Phosphates in Morocco

Five hundred tons of phosphates from Onedzem are now being shipped weekly to France. It is estimated that the yearly output at Onedzem will reach 500,000 tons in 1926, 1,750,000 tons in 1930 and 3,000,000 tons in 1940.

Germany Advances Prices of Dyes

Manufacturers in Germany have advanced the prices of dyes for silk piece goods 300 per cent.

Appointment of Chemistry Chief to Be Delayed

In all probability no nomination will be made until after the first of the year to fill the vacancy made by the resignation of Dr. Carl L. Alsberg as chief of the Bureau of Chemistry of the Department of Agriculture. Despite earnest efforts on the part of Dr. E. D. Ball, Assistant Secretary of Agriculture, who is handling the matter, no properly qualified chemist has been found who is willing to take the place at the present salary of $5,000. As a result of that situation, it is understood that an appropriation of $7,500 will be asked. No action on such an appropriation is likely before March. Last year the appropriations committees declined to increase the salaries of any one position until a report could be had from the reclassification committee. When that report is in hand it is expected that there will be a uniform increase in the salaries of all heads of bureaus, as well as in many subordinate positions.

Protest Spanish Tax on Pyrites

Spain's proposal to place an export tax of eight pesetas per metric ton on iron pyrites is receiving active attention at both the State and Commerce Departments. Informal protests already have been filed with the Spanish Government and the matter has been discussed extensively by the Spanish Ambassador to Washington and representatives of the sulphuric acid industry. A decision by the Spanish Government is expected before the end of September. If it should be decided to impose an export tax on pyrites of even as much as $1 per ton, it would act as a very decided stimulus to the domestic sulphur industry and probably would encourage considerable activity in the mining of pyrites in the United States.

Ask Embargo on Chemical Stoneware

The manufacturers of chemical stoneware have joined in submitting a brief to the Finance Committee of the Senate asking that their products be protected by a duty of 200 per cent, which they admit to be practically an embargo. The tariff bill as passed by the House provides a duty of 35 per cent ad valorem on chemical stoneware, chemical porcelain and other vitrified wares. The manufacturers of stoneware contend that their industry is relatively of as great importance as is the dye industry, since carefully and laboriously made stoneware is absolutely essential in the handling of acids, alkalis and other chemicals. It was pointed out that no machinery is used in this industry except in the grinding of the clay. Labor, which must have a special expertness, represents more than 80 per cent of the total cost of the finished product. It was contended that chemical stoneware should be taken out of the paragraph containing porcelain and other vitrified ware and placed in a paragraph by itself.

American Wood Preservers' Association Establishes Service Bureau

To promote the use of wood properly treated to resist decay, marine borers and insect attack, thereby aiding in the conservation of the forest resources of the nation, the American Wood Preservers' Association has established a Service Bureau.

The value of wood for construction purposes is fairly well understood, but for permanent structures treatment with a standard preservative, such as creosote or zinc chloride, is absolutely necessary. The policy of the Service Bureau is to give the public reliable information on the treatment of timber according to the standards of the American Wood Preservers' Association, and on the use of treated wood. The bureau is located at 1146 Otis Building, Chicago. P. R. Hicks is secretary-manager.

T.A.P.P.I. Meeting

A joint meeting of the Technical Association of the Pulp and Paper Industry and the American Pulp and Paper Mill Superintendents' Association will be held at Washington, Oct. 18 to 21, with headquarters at the New Willard. The preliminary program follows:

TUESDAY, OCT. 18

9 a.m.—Assemble at Industrial Building of the Bureau of Standards for reading and discussion of papers in general and group meetings arranged by T.A.P.P.I. Service Committee, and committee of A. P. & P. M. S. A.

12:30 p.m.—Luncheon, Bureau of Standards.

2 p.m.—Inspection of sections of the Bureau of Standards; visit to paper and dye laboratories of the Bureau of Chemistry; optional visits to Government Printing Office, Bureau of Engraving and Printing, and mill of District of Columbia Paper Manufacturing Company.

7 p.m.—Supper at New Willard Hotel, followed by smoker, and continuation of papers, group meetings and discussions.

12 m.—Take Pullman cars for York, for visits to York, York Haven and Spring Grove, Pa.

WEDNESDAY, OCT. 19

Mill and plant visitations in York, York Haven and Spring Grove, Pa. Leave Washington for York, Pa., by midnight train. Breakfast on arrival at York. Visits to plants in York and York Haven, followed by trip to Spring Grove in afternoon. Leave York for Philadelphia in evening.

THURSDAY, OCT. 20

Breakfast in Philadelphia at Bellevue-Stratford, association headquarters, where members and guests will register for visits to the various mills and plants to be inspected during the day.

7 p.m.—Banquet at Bellevue-Stratford.

FRIDAY, OCT. 21

Excursion to Wilmington, Del. Leave Philadelphia for Wilmington by early train. Breakfast at cafeteria of Pusey-Jones Co. on arrival, followed by visits to plants as follows: Pusey-Jones Co., du Pont Co.'s plant at Carney's Point, inspection of laboratory and dye works of the du Pont Co.

Naval Stores and Fertilizer Movement for the Past Fiscal Year

The data on the movement of naval stores—rosins and turpentine—show a marked decrease in the demand for domestic rosins, with almost as great an increase in the call for our turpentine, as compiled by the Bureau of Foreign and Domestic Commerce for the fiscal year ended June 30.

During the past three years American rosin was purchased abroad to the following extent: 881,777 bbl., valued at $11,323,381, in 1919; 1,322,034 bbl., valued at $24,847,691, in 1920; and 877,160 bbl., valued at $10,364,804, in 1921. The decrease in quantity during the past year was 34 per cent; the average price per barrel, however, dropped from $18.80 to $11.82. During the month of June there was a noticeable increase in this product and exports advanced from 70,938 bbl., valued at $1,306,279, for June, 1920, to 101,189 bbl., valued at $516,791, in 1921. The price one year ago was $18.79 per bbl. For June, 1921, it averaged $11.82.

The sales for export on our spirits of turpentine amounted to 8,064,578 gal. ($6,069,853) in 1919, 7,461,355 gal. ($11,121,864) in 1920 and 9,741,711 gal. ($11,279,353) in 1921. The increase during the past year was 30.7 per cent. The price per gal. averaged $1.49 in 1920 and $1.16 during the past fiscal year. A pronounced increase in shipments of turpentine was recorded in June. A year ago figures for the month were 360,213 gal., valued at $664,655. In June, 1921, there was 1,477,416 gal., invoiced at $867,302. The export price of $1.84 per gal. in June, 1920, fell to 59c. in June, 1921. Great Britain takes 53 per cent of our shipments of turpentine; Canada is next with 9.6 per cent. Other leading markets in decreasing order of importance are Holland, Belgium and Argentina. Great Britain is also the leading market for American rosin, purchasing 33 per cent. Brazil takes 14 per cent, Argentina 12 per cent, Canada 9.6 per cent and Australia 4.6 per cent.

Tar, pitch and minor naval stores were exported to the extent of 48,008 bbl., valued at $384,263, during the fiscal year 1919; 61,790 bbl. ($534,175) in 1920, and 41,864 bbl. ($380,267) in 1921. In June, 1921, the exports in this class were 2,098 bbl., valued at $15,857, as compared with 5,357 bbl. ($49,730) during the previous year.

The total value of our exports of naval stores amounted to $17,777,497 in 1919, $36,503,720 in 1920 and $22,024,424 in 1921. In the fiscal year 1913-1914 it was $19,882,165.

In volume our shipments of rosin for the past year were 36 per cent of the exports of seven years ago. Turpentine shipments are now but one-half those recorded just before the war. Tar and pitch have dropped 88 per cent.

The fiscal year figures covering the fertilizer materials show a slight gain over the previous year. During the month of June, however, the imports became practically negligible, while the exports were about one-third the value and two-thirds the volume for the same month in 1920. In the latter month we exported 112,708 long tons of fertilizers valued at $2,862,688. In June this year the shipments were 75,391 long tons, valued at $971,757. The heaviest reductions were in ammonium sulphate and miscellaneous fertilizers and also in superphosphates, which fell from 1,038 to 70 tons. Raw phosphate rock decreased 23 per cent. Imports in this group amounted to 96,796 tons in June, 1920, valued at $3,441,616. In June of this year the total was 4,642 tons, valued at $183,983. This downward trend was most marked in the potassium salts group. The chloride dropped from 4,811 to 10 tons; manure salts from 24,642 to 105 tons.

During the fiscal year ended June 30, 1919, we imported fertilizers to the amount of 118.236 long tons, valued at $5,883,376; 867,623 tons ($38,578,063) in 1920; 608,287 tons ($28,550,111) in 1921. During the past year, as compared with the previous one, there was a decrease of 30 per cent in volume and 26 per cent in value. The drop is less than that for chemical products in general, which is 30.5 per cent. Some increases in the volume of imports are recorded. Potassium sulphate and guano doubled; bone in various forms advanced from 7,340 to 27,413 long tons; on the other hand, calcium cyanamide dropped 50 per cent; manure salts 51 per cent; potassium chloride 55 per cent.

There was a drop of 24.8 per cent in the value of fertilizers exported during the fiscal year 1921. The outward movement in 1919 was 346,944 long tons ($9,405,242); in 1920 it reached 1,129,369 tons ($33,243,411); in 1921 it totaled 1,147,864 tons, of a value of $24,969,271. Superphosphates lost 68 per cent, and ammonium sulphate dropped 58 per cent in quantity and 40 per cent in value. Ammonium sulphate itself has become a leading factor in our fertilizer exports. During the past year it constituted 30 per cent of the total value. Noteworthy is the movement of ammonium sulphate. During 1913-14 we imported 74,440 tons. In the fiscal year just ended our imports were 2,537 tons, while we shipped abroad 65,915 tons—almost as much as we purchased from Europe seven years ago.

New Navy Wage Scale Fixed

The Navy Wage Board has recommended and the Secretary of the Navy has approved a new schedule of wages for all the employees of the navy establishments. The schedule for chemists ranges from $10.56 per day to $7.20 per day. Chief chemists are to receive $11.36 per day. Assistant chemists are to receive from $6.88 to $4.88. Chief metallurgists are to receive $3,000 per annum. Assistant chief metallurgists are to receive $8.32 per day. Chemical laboratorians are to receive $5.36 and $4.56 per day.

Ford Invited to Washington

The Secretary of War has invited Henry Ford to come to Washington to discuss Mr. Ford's proposal to take over the Muscle Shoals water power project and nitrate plant. At the time of this writing, Secretary Weeks had not heard whether or not Mr. Ford will accept the invitation.

India Imposes Export Tax on Lac

The government of India has approved the imposition of a small export tax on lac, in order to finance research work in connection with the lac industry.

A bill authorizing the tax will be introduced in the ensuing session of the Indian Legislature.

The Ceramic Station of the Bureau of Mines Investigates Industrial Burning Problems

The Ceramic Experiment Station of the U. S. Bureau of Mines has entered into a co-operative agreement jointly with the Common Brick, Face Brick, Paving Brick and Hollow Building Tile Associations, in order to investigate problems in connection with burning clay products. The ultimate objects of the work are to conserve fuel, shorten the time of burning and improve the qualities of the products.

The four clay associations have contributed a joint fund of $10,000 for the investigation. Of that sum $7,500 has been allotted to the Ceramic Experiment Station of the Bureau of Mines for making field investigations on industrial kilns. In addition to this sum the Bureau of Mines purposes to spend $15,000 or more.

The kiln investigations will consist in obtaining data on fourteen or more kilns to determine the amount of fuel used, the amount of ware placed in the kiln, temperatures at three different levels during the process of burning, temperature of the flue gases, analysis of the flue gases, the end point of water smoking, the end point of oxidation, length of time for burning, analysis of the fuel and ash, drawings of the kilns showing dimensions, their age and condition as to repairs. From the study of the data obtained changes in the construction of the kilns, the shortening of the time of burning and change in method of setting and firing are to be made. From isolated cases where similar kiln studies have been made as much as 0.5 ton of coal per 1,000 brick has been saved and a shortening in the time of burning of as much as 25 per cent. On a plant of 20,000,000 annual brick capacity it is possible to make a saving of from 5,000 to 10,000 tons of coal annually. This is especially true in plants where firing conditions are exceptionally bad.

The work will be under the supervision of R. T. Stull, chief ceramist of the bureau, who has placed three ceramic engineers on the field work. In connection with the field studies the services of the fuel section of the bureau will be available and the services of a fuel engineer will be placed on the work for at least six months. Laboratory studies are also to be made at the ceramic station on oxidation and vitrification problems.

Transportation of Dangerous Materials

Effective Sept. 1, the Interstate Commerce Commission has placed amended regulations in force governing the transportation of arsenic, paris green, arsenate of lead, calcium arsenate and other such materials. Such articles must not be offered or accepted for shipment in bulk, but must be packed in strong and tight containers, of type to prevent sifting or escaping of contents in transit. Permission is allowed, however, for the shipment of sintered arsenical flue dust in steel gondola cars, with suitable covers, between plants.

Radium Plants Merge

The United States Radium Co., New York, recently organized, will take over a number of the larger radium companies in this country, including the Radium Luminous Material Corp., 58 Pine St., New York, with works at Orange, N. J.; the subsidiaries of the latter company will also be included in the merger, and the Undark Radium Mines, in the Paradox Valley section of Colorado. The radium works and extraction plant at Orange will be continued in operation by the consolidated company, and also the radium research laboratory of the Undark organization. Arthur Roeder is chairman of the board of directors of the new company.

Glass Workers Accept Wage Reduction

Skilled operatives and other workers at the "hand plants" devoted to the manufacture of sheet glass have accepted a wage reduction of 28 per cent, effective Sept. 6, as a result of a series of conferences between representatives of the Window Glass Manufacturers' Association of America and the American Window Glass Workers. About 18,000 persons are affected by the reduction.

Non-Metallic Investigations of Bureau of Mines

Experimental work on cement and heavy clay products for which Congress recently apropriated $35,000 now is under satisfactory headway at the Bureau of Mines ceramic station at Columbus, Ohio.

The Department of the Interior, which is a large buyer of cement, felt the lack of certain technical and economic data regarding the cost of raw materials, of burning and of the factors entering into quality and deterioration. At the same time the building industry was stagnant, in part because of the high cost of materials in which fuel and labor were the main items. The manufacture of the non-metallic building materials, except perhaps in the case of cement, is conducted in small scattered plants few of which have adequate technical knowledge or direction, the situation being similar in many particulars to that of the small farming industry. It is the purpose of this appropriation, at once to develop improved technology where that may be possible, and to disseminate widely among the smaller producers knowledge of the best current practice to the end that costs and wastes be reduced.

Much of this appropriation is being expended through the bureau's ceramic station at Ohio State University. A study has been started there of the technology of the cement industry, particularly as to choice of raw materials, economic use of fuel and related economic problems of transportation. To this has been allotted $10,600 and the co-operation of the Department of Commerce has been arranged.

Other non-metallics, including the mining and utilization of feldspar, phosphate rock, slate and potash, are being studied and efforts made to reduce cost of production and utilization of byproducts hitherto considered waste. To this work $5,700 has been allotted.

Several basic ceramic chemical problems connected with the burning of clay products will be worked out at the University of Illinois under the direction of a consulting ceramic chemist. For the carrying on of this study $1,000 is allotted.

Society of Industrial Engineers to Meet in Springfield

One of the most important industrial meetings of the year will be the fifth annual convention of the Society of Industrial Engineers, to be held in Springfield, Mass., Oct. 5, 6 and 7. In the membership of this national organization are business executives and industrial engineers from almost every line of industry, which naturally tends to add interest to the national meetings.

Industrial stability will be the main theme for discussion, the topics on the program covering four of the major functions of industry—production, finance and accounting, sales, and industrial relations. All the speakers will be men of broad practical experience and national reputation.

Afternoon and evening sessions will be held on each of the three days, the mornings being devoted to visiting some of the most progressive plants in the Springfield district. All the sessions will be open to the public.

Uncertain as to Potash Discoveries

Every effort is being made by the United States Potash Producers' Association to ascertain the real facts in regard to the discovery of potash in two oil wells drilled in western Texas. While there is no disputing that material which carries as much potash as does the German product has been found, no information reaching the Potash Producers' Association carries with it any proof that the potash deposit is of sufficient thickness to justify the expensive mining operations which would be required to recover it. It is believed that it will require diamond drilling to get definite data as to the occurrence of potash-bearing material in commercial quantities.

British Chemical Dispute Settled

A settlement of the dispute in the chemical industry has been effected.

Metric System Hearings

A sub-committee of the Senate Committee on Manufactures has been designated to conduct hearings on a bill by Senator Ladd, of North Dakota, providing for the compulsory adoption, after ten years, of the metric system of weights and measures. Senator McNary, of Oregon, will act as chairman of the sub-committee. The other members are Senator Weller, of Maryland, and Senator Jones, of New Mexico.

It is the intention to have limited hearings shortly after the congressional recess, so that the proponents and opponents of the legislation may state their views as to the desirability of such a law. It then is the intention to circulate as widely as possible a stenographic record of the hearing, with the idea of acquainting the public with the problems involved. Later, during the regular session of Congress which begins in December, it is planned to have further hearings, after which an attempt will be made to get favorable action by the committee, thereby obtaining a place for the bill on the Senate calendar where its consideration would be taken up in due course.

Experimental Paper Mill Being Sent to Siam

As a result of tests made on the experimental paper machine at the Bureau of Standards using rice straw, banana tree stems and lalang grass from Siam, Siamese officials saw the possibilities of the paper industry in their country and their government asked the American Government, through the State Department and the Department of Commerce, to supervise the design and purchase of a similar experimental machine.

Although not intended primarily for commercial purposes, the machine which is now en route will furnish the writing and printing paper for the Siamese army. It will be erected at Bangkok, Siam, under the supervision of the Royal Survey Department of the army.

The paper mill consists essentially of a 44-in. Fourdrinier paper machine, two 300-lb. beaters, a small Jordan engine, a 600-lb. rotary boiler, a cylinder duster, screen, sheet cutter, suitable pumps, shafting, pulleys and motors, bleach plant, necessary electrical fittings, and plumbing, belting and spare parts. It is capable of producing 1,200 lb. of paper per day.

Iron Industry at Buffalo Resuming Activity

A number of the iron and steel plants at Buffalo, N. Y., are resuming production on an increased scale, following a long period of inactivity. The Lackawanna Steel Co. is now operating nine of its rolling mills and adding many former employees to the working force. This company has entered the pig iron field, and is reported to have sold about 30,000 tons in recent weeks. The Wickwire Steel Co. has placed a number of additional mills in service, with increased working force, while the plant of the Seneca Iron & Steel Co., at Blasdell, near Buffalo, is again in operation after a period of idleness. Production is still curtailed at the local works of the Rogers, Brown Co.

Hungarian Banks Organize Company to Manufacture Artificial Manures

Some of the largest Hungarian banks have organized a company for the purpose of transforming Magyarovar Munitions Works into a plant for the manufacture of artificial manures.

Duties for Non-Metals Asked

One of the features of the hearings before the Finance Committee of the Senate has been the particularly strong pleas that have been made for protection sufficiently high to allow the domestic mining of the non-metals to flourish.

Few Purchases of Heavy Chemicals in Brazil

Due to the uncertainty as to exchange, few purchases of heavy chemicals are being made in Brazil, say cable advices to the Department of Commerce.

Glass Plant Operations in West Virginia

Despite the decreased demand for flint glassware during recent months, the different plants of this character in the Wheeling, W. Va., district have been making a number of improvements and expanding their works. The slack period of the past eight weeks particularly has been used to good advantage in this direction. The majority of the plants are now in condition to meet all expected demands, and the general situation in the industry is showing noticeable improvement.

The cut glass and gift glassware plants in this section report an increased volume of business and large number of inquiries for material for fall and holiday trade. Blown and etched tableware glass plants also are receiving larger orders, and current business is better than for a number of months past.

Bottle and jar manufacturers in the district have been engaging on an improvement program during recent months, with a number of plant extensions and betterments, as well as repairs to machinery and equipment. This branch of the glassware industry reports an increased demand for material. Plants devoted to the manufacture of lamp chimneys and kindred glassware have been operating on a much curtailed schedule for the past three or four months, with present indications that production can be resumed on a near-normal basis at an early date.

Glassware for lighting service is showing an improved demand, and plants engaged in this line are commencing to increase production in anticipation of a good holiday business.

Artificial Leather From Cordite

Following experiments and investigations for a year past, the chemical department at the plant of the Ford Motor Co., Detroit, Mich., has perfected a process for the manufacture of artificial leather from cordite gunpowder, a high explosive. The new development will be utilized at the leather works of the company at once. It is said that a purchase of 857 carloads, or about 35,000,000 lb. of the material has been made from the British Government, at a price less than one-fifth of the war-time value of cordite. It will be transferred to the Highland Park works in such quantities as needed for artificial leather production. The new process is stated to reduce the cost of manufacture about one-half. The local plant of the company has an average output of about 25,000 sq.yd. of artificial leather per day, the entire production being used on Ford automobiles.

Internal Revenue Collections

An analysis of internal revenue collections during the fiscal year ended June 30 shows that the tax on perfumes, cosmetics and medicinal articles produced $5,800,768.41. This shows a slight decrease from the revenue derived from these sources during the preceding fiscal year, when it was $6,427,881.08. The levy on toilet soap and toilet soap powders produced $2,223,773.99. This is an increase over the collection during the fiscal year ended June 30, 1920, when collections under that head totaled $1,919,398.44. The tax on importers, manufacturers, compounders and dealers in opium, coca leaves and their salt derivatives, including the tax on the product, amounted to $1,161,174.12. In the preceding fiscal year the collection from the same sources was $1,153,919.50.

British Columbia Paper Plant Reopens

The Whalen Pulp & Paper Co. reopened its plant at Wood Fibre, B. C., on Aug. 15. This plant of the Whalen company produces only pulp suitable for the manufacture of book paper; the demand for this class of pulp fell off early in the season, and the plant was closed. T. W. McGarry, president of the company, states that conditions now have improved, and it is expected that the Wood Fibre plant will be worked at capacity and will give employment to about 300 men. The Whalen company's Port Alice plant, which produces pulp for newsprint paper, has been working at capacity and turning out 1,800 tons of pulp weekly. The Reliance Mill & Trading Co. has retired from the management of the Whalen company's plants.

Personal

HAROLD W. ABBOTT, former technical supervisor at the Massena plant of the Aluminum Co. of America, has accepted a position along the same lines in the research and development division of the Stackpole Carbon Co., St. Mary's, Pa.

Dr. RAYMOND F. BACON has resigned as director of Mellon Institute to take effect Jan. 1, 1922. Dr. E. R. Weidlein has been appointed acting director.

OSCAR H. BETTS has been elected president of the Bethlehem Paper Co., Bethlehem, Pa.

H. S. BOUTELL has been elected treasurer of the Detroit Graphite Co., Detroit, Mich., succeeding W. F. Monroe, resigned.

C. S. BRYAN has become connected with the Provident Chemical Works, St. Louis, Mo., as chemical engineer. He was for several years with the Virginia-Carolina Chemical Co. as superintendent and research chemist, and more recently has been acting as manager of the Charleston Chemical Co., Charleston, S. C.

Dr. F. G. COTTRELL, head of the chemical activities of the National Research Council, will sail from France on Oct. 11 on his return to the United States. Dr. Cottrell has spent the summer in Europe studying various phases of the chemical industry. Among other things he paid particular attention to the liquefication of gases.

O. D. CUNNINGHAM has become connected with the physical chemistry department of the plant of the Republic Creosoting Co., Indianapolis, Ind., to engage in research work. He was engaged formerly in a similar capacity at the plant of the National Aniline & Chemical Co., Buffalo, N. Y.

Dr. F. A. GILGILLIAN has become connected with the research department of the Calco Chemical Co., Bound Brook, N. J.

RALPH C. HOLDER recently resigned as junior chemist in the food research laboratory, Bureau of Chemistry, to accept a position as chemist in charge of the chemical laboratory for the Collis Products Co. at St. Paul, Minn.

B. B. GOTTSBERGER was recently elected secretary of the Mining and Metallurgical Society of America, and assumed the duties of that position on Aug. 1.

H. B. MYERS has resumed his position as head of the finishing department at the plant of the Hartford City Paper Co., Hartford City, Ind., after an absence of about ten months, during which time he has been connected with a paper mill at Bryn Mawr, Pa.

JOHN F. SLEEPER, author and chemist, is retiring to his fruit ranch at Santa Barbara, Cal., and leaves his home in Tenafly, N. J., the middle of September.

Dr. REUBEN S. TOUR, Government chemical expert, has been appointed professor of chemical engineering at the University of Cincinnati, Cincinnati, Ohio, succeeding Dr. O. R. Sweeney, who resigned because of ill health. Dr. Tour will continue as a consulting expert for the Government. His new duties began Sept. 1, 1921.

Obituary

CHARLES H. FOOTE, well known in the steel trade as an officer of the Illinois Steel Co. for a number of years, died on Aug. 28 at Burlington, Vt., aged seventy-nine. Mr. Foote leaves two daughters, and a son, Thomas W. Foote, of Cleveland.

WILLIAM VOGEL, of Proffit, Va., secretary-treasurer of the Ohio Sulphur Mining Co., died at the University Hospital, Charlottesville, Va., Aug. 17, from peritonitis.

Current Market Reports

The Chemical and Allied Industrial Markets

NEW YORK, Sept. 12, 1921.

Chemical trading continues to show a gradual improvement, especially in the fertilizer trade, where firmer prices have been reflected. Miscellaneous inquiries have been freer and more business is passing through export channels, particularly to South America, Japan and some European centers. This clearly indicates that large surplus stocks held by these countries have finally been absorbed and that a steady expansion in trade may be expected to develop in the near future. Increased production at some of our largest caustic soda and soda ash plants is an extremely optimistic sign and bids fair to dispel some of the gloom surrounding these items. Ammonium sulphate is in strong demand in view of the limited supplies available. The activity of fertilizers has resulted in greater activity in sulphuric acid and this has reflected itself in other directions in the heavy chemical market. While general trading is not very broad, the market is beginning to feel the stimulating influence of inquiries from the paper, textile, glass, tanning and other consuming industries. Sales all around are larger than a month ago and more transactions are noted. Those close to the pulse of trading expect a good volume of business during the last quarter. Outside developments have been quite favorable. Our export trade is showing a spark of real snappy improvement. Sound and effective measures have been provided for the farming industry. The only thing that is keenly awaited is a wise tariff policy.

CHEMICALS

Prices on *caustic potash* have recently been advanced and some of the largest sellers are refusing to shade 4½c. per lb. for either spot or forward shipments of the imported 88-92 per cent. It is stated that a few odd lots might still be purchased at 4⅝c., but the tone of the market is decidedly firmer. There were rumors that some producers abroad have stopped making this product on account of the relatively low price. Spot *bichromate of soda* was quoted at a higher price in several directions and the general range was 8@8¼c. per lb., although a few small lots might be purchased at a slight concession. The movement at present is confined chiefly to small quantities, as consumers appear satisfied to operate very cautiously.

Buying orders on *ammonium sulphate* have been in the market during the past week from Japan and Spain and large lots of sulphate have been moved out on them. The consequence has been a rise in the export price to $2.40 per 100 lb. in double bags, f.a.s. New York. Makers are unable to quote for prompt delivery, but name a nominal price of $1.90 per 100 lb. for bulk sulphate at the works. Prices on *barium chloride* are weakening on competition among importers. The price of $45 per ton for spot goods can probably be shaded considerably for firm business in quantity. The resale *bleaching powder* market is stiffening as stocks keep moving. The quoted price of $2.05 per 100 lb., f.o.b. works, is becoming increasingly hard to do. Makers quote 2¼c. per lb. for prime bleach at the plant. Spot prices are around $2.60 per 100 lb.

Dealers of solid *caustic soda* quote $3.85 per 100 lb. at the works, while spot material of standard make is held at $3.90@$4 per 100 lb., with sales reported at $3.95. Additional export business of moderate dimensions went through at 4c. per lb., f.a.s. New York, for South America. Producers are holding the market steady at 3¼c. per lb., basis 60 per cent, f.o.b. works, in carload lots. The tone of the general market may be described as steady. A slow demand for *copper sulphate* has forced importers' prices down to 5c. per lb. on spot. In the absence of any noticeable business, makers have not reduced their prices below 5¼c. per lb. Large lots of *hyposulphite of soda* are quoted at $3.40 per 100 lb., while small lots on spot have commanded up

to 3¾c. per lb. The market remained steady. Demand for spot *prussiate of soda* is active enough to hold the market firm at the late advance. While 12½c. per lb. might be done in some quarters, in others 12¼c. was quoted. Spot supplies are not heavy and it is said to be doubtful if prompt shipment can be purchased at prices much below those prevailing in the spot market. Dealers are holding light *soda ash* in single bags at prices ranging from $2.05@$2.15 per 100 lb. on spot. Sales of barrels have been reported by second hands at $2.45@$2.50 per 100 lb. The tone of the market is firm, with a better inquiry reported by both makers and dealers. At the works $1.60 per 100 lb. is named for single bags in carload lots, basis 48 per cent. Fused 60-62 per cent *sodium sulphide* is moving at 4½c. per lb. for the imported grade. In one quarter the sale of 100 tons at this figure was noted. Small lots are quoted up to 5c. per lb. The broken variety is quoted at the same price as fused. Domestic producers quote fused at 5¾c. per lb. in carlots and broken at 6c.

Commercial *white arsenic* is quoted on the spot at 6¼@6½c. per lb. The movement of late has been rather quiet and the tone has been a shade easier on account of the absence of support. *Red arsenic* is also moving quietly at prices ranging from 11@12c. per lb. Producers of *formaldehyde* report sales at 12@12½c. per lb. in barrels, f.o.b. works. The spot market is quoted at 12½@13c. per lb. in most directions. A moderate inquiry is reported, with some first hand sales at the inside figure. Sales of technical *magnesia carbonate* in bags are reported on the basis of 8½c. per lb. Sales of barrels are reported at 9½c. Kegs are quoted up to 10½c. Irregular activity is noted in the market, with consumers buying only actual wants. Spot *oxalic acid* is quoted from 16@17½c. per lb., depending upon the quantity, brand and seller. The best open price given by producers is 16c. per lb., at the works, although it is understood that actual sales have gone through a shade under this figure. Small lots are attracting the attention of consumers and in the aggregate a fair volume of business is passing.

PRICE VARIATIONS OF INDUSTRIAL CHEMICALS
DURING AUGUST, 1921

Article		Open	High	Low	Close
Acetate of soda	lb.	$0.04½	$0.04½	$0.04	$0.04
Arsenic, white	lb.	.06½	.06½	.06½	.06½
Bicarbonate soda	lb.	.02½	.02½	.02	.02½
Bichromate soda	lb.	.08	.08	.07½	.07½
Bleaching powder	lb.	.02½	.02½	.02	.02½
Carbonate potash, 80-85 per cent	lb.	.05	.05½	.05	.05
Caustic potash, 88-92 per cent	lb.	.04½	.04½	.04	.04½
Caustic soda	lb.	.03½	.04	.0360	.0390
Citric acid	lb.	.44	.45	.44	.45
Formaldehyde	lb.	.12½	.13	.12½	.12½
Muriate potash	ton	45.00	45.00	42.50	42.50
Oxalic acid	lb.	.17	.17½	.16	.16
Permanganate potash	lb.	.26	.26	.26	.26
Soda ash	lb.	.02	.02½	.0190	.02½
Sulphide soda	lb.	.04½	.05	.04½	.04½

Coal-Tar Products

Considerable improvement was noted in the general list of coal-tar products during the past week. Consumers are taking on supplies to cover their requirements at least until the expiration of the emergency tariff and in this way quite a volume of business has been done. The intervention of the holiday had some effect in limiting the number of buying orders, but in spite of this, prospects for the immediate future are much brighter than a few months ago. The financial weakness of some makers of intermediates has forced sales at reductions, but as a rule prices are holding well. Resale *benzene* is very difficult to find and prices are well above refiners'. The 90 per cent has sold at 38c. per gal., with 40c. quoted for c.p. Refiners are offering only for future delivery at 27@33c. per gal. for c.p. and 25@31c. for 90 per cent. The English market for *cresylic acid* is holding firm. Spot supplies are sufficient to take care of the present demand, but any sustained inquiry would deplete stocks considerably and probably lead to higher prices, as replacement costs are above present selling levels. Insecticide makers are displaying interest and most of the present buying is being done by them. The 97@99 per cent is quoted at 70@75c. per gal., with the 95 per cent at 60@65c. per gal. The demand for *toluene* is moderately active and the scarcity of benzene tends to strengthen the market. Resale goods are selling at 36@40c. per gal. in drums with refiners quoting 27@34c. per gal. Prices on *phenol* are quoted lower on light demand. Resale offers of limited quantities are heard down to 8¼c. per lb. Resale stocks of *aniline oil* are large and competition among sellers is keen. Business is still passing at 18@18½c. per lb., although producers' lowest figures are 20c. A fair amount of small-lot buying is being done, but round lot sales are infrequent. Sellers of *aniline salt* quote from 25@28c. per lb. The demand is confined to small quantities, with practically no export business recorded. A slight improvement is noted in the demand for *dimethylaniline*. Resale goods are held at 43@45c. per lb. with first hands asking up to 50c. The lowest quotation heard on *diphenylamine* is 62c. per lb., with 75c. asked in some directions. The demand is slightly better, but it is mostly small-lot orders that are being booked.

Waxes

There was a firm market for both crude and refined *beeswax*. African crude on spot closed at 16@16½c. per lb., while on forward business the ideas of sellers ranged from 14½@15c. per lb., depending upon the quantity. Brazilian crude held at 22@24c. per lb. Pure white refined was quotably unchanged at 36@42c. per lb. Offerings of *Carnauba wax* were not pressing, and with reports from primary centers holding steady, quotations were well maintained on a basis of 25@26c. per lb. for the No. 2 North Country, with No. 3 North Country slightly lower, at 14½@15c. per lb. The spot situation in *Japan wax* was strong and for small quantities prices as high as 25c. per lb. were paid. For goods to arrive the market ranged from 21@22c. per lb. Futures were firmly maintained, leading factors quoting from 18@19c. per lb., according to brand and quantity. The general spot quotation ranged from 24@25c. per lb. The export inquiry for *paraffine wax* has shown slight improvement, but with stocks on hand liberal, selling pressure continues and prices present a rather unsettled appearance. Crude *scale wax* of 122 to 124 degree melting point was available at 1½c. per lb., carload lots, prompt shipment from works. *Match wax* held around 3¼@3½c. per lb., barrels included.

The Iron and Steel Market

PITTSBURGH, Sept. 9, 1921.

Scrutiny of details as to the buying and selling of steel mill products, with an open mind, leads to a clear conception of the underlying conditions and the prospects for the nearby future, while attempts to appraise the present steel market in the light of market "movements" before the war bring only confusion. Such confusion is disclosed in much of the comment that is made in relatively uninformed quarters, where what may be called criticism of the present steel market is indulged in.

Thus it is impatiently remarked sometimes that there is "no forward buying" of steel products, as if nothing could be good or encouraging in steel without the performance indicated. The steel mills had an average operation of less than 20 per cent of capacity at the middle of July, and their owners put many things ahead of a desire to have a full operation Christmas week. In the market movements before the war much of the forward buying was predicated not so much upon requirements the buyer was assured he would have as upon a belief that prices were going to advance. First, prices were allowed to go too far down. Then buyers were permitted to buy at those prices for prompt delivery. Next they were permitted to contract a short time ahead at a slight advance. After a short time another advance would be made, and buyers would be permitted to "cover" for an additional period. This was the regular performance, and it was prolonged until it became top heavy. One must not expect that sort of thing now. The desire of steel producers is not to advance prices above the present level, but to reduce costs.

Then there is complaint that the Steel Corporation's "unfilled tonnage" does not increase when it is reported that more steel is being bought. The condition, of course, is that the corporation has contracts with nearly all its customers, these contracts being represented in the "unfilled tonnage" reported month by month. The orders the

corporation receives are chiefly specifications against these contracts. The more business the corporation receives the more tonnage it ships and the more its unfilled obligations decrease. If bond interest and dividends are to be paid, they will be paid by the steel that is shipped and paid for, not by the contracts that fail to be specified against. The July decrease in the "unfilled tonnage" was less than the June decrease, because the corporation shipped less steel.

Production

There has been a slight upward trend in the production of pig iron in the past few weeks, but a more distinct increase is to be expected in the next few weeks. The rate now is about 25 per cent of the actual capacity. Steel ingot production is increasing, in general, but at a very slow rate, production being now in the neighborhood of 30 per cent of capacity, this being fully one-half greater than production at the low point, about the middle of July.

Tonnage output, however, is not an altogether fair criterion as to the improvement that has been occurring in fundamental conditions relating to steel demand, for the reason that the increase in demand has been almost wholly in the lighter finished steel products, particularly sheets, tubular goods, tin plate and merchant bars, where a given tonnage means more than a similar tonnage in plates, shapes and rails, which have shown scarcely any improvement.

The American Sheet & Tin Plate Co. (Steel Corporation) had last week both the largest volume of orders and specifications and the heaviest shipments of its products, tin plates and sheets, for any week since last April, and for this week it has scheduled a 50 per cent operation for both sheet mills and tin mills. There was a time recently when there was only about a 25 per cent operation in each class. Bookings of the pipe mills were 30 to 35 per cent greater in August than in July. Merchant steel bars showed a smaller improvement.

Demand for steel for construction purposes has had its ups and downs, with no important improvement plainly marked. Just at the moment it would appear that the trend is distinctly upward, but on account of the season of the year no great amount of reliance should be placed on this showing.

Steel Prices

Bars, shapes and plates can be bought at prices ranging, roughly speaking, from 1.65c. to 1.75c., depending on the size and desirability otherwise of the order offered. The range is narrower than a month or six weeks ago, and the average is but little lower. Sheets are very steady since the recent declines to 2.25c. for blue annealed, 2.75c. for black and 3.75c. for galvanized. Shading in standard steel pipe generally does not run more than $2 a ton at the outside from the prices openly named July 9. Wire products are quite steady at prices developed two months ago, 2.50c. for plain wire and $2.75 for nails. Altogether, while the steel market may not have struck bottom for the nearby future, it is amply near enough for safety to those who buy for nearby requirements, and no one has occasion to buy otherwise. Even for a construction job that would be expected to yield a return over a period of many years, the possible decline in prices of mill products would not be a serious drain upon annual earnings. If there is disinclination to buy steel for construction work, it is due to the cost of putting the steel into employment, or uncertainty as to earnings of the structure, rather than to the cost of the steel itself.

Pig Iron and Coke

Pig iron continues to show, in general, a slight stiffening tendency, this being due, as previously indicated in these reports, to unexpected delay in reductions in freight rates, which would lower the cost of production, while there has been liquidation of furnace stocks. In the local market bessemer and basic are quotable unchanged at $20 and $19 respectively, f.o.b. valley furnaces, while foundry iron is up another 50c., to $21 valley.

Connellsville coke has advanced 25c., to $3.25 for furnace and $4.25 as minimum for foundry, some brands commanding $4.50 as hitherto.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

		Carlots	Less Carlots
Acetic anhydride	lb.	..... –	$0.40 – $0.45
Acetone	lb.	$0.12½ – $0.12¾	.13 – .13½
Acid, acetic, 28 per cent	100 lbs.	2.50 – 2.75	3.00 – 3.25
Acetic, 56 per cent	100 lbs.	5.00 – 5.25	5.50 – 6.00
Acetic, glacial, 99½ per cent, carboys, 100 lbs.		10.00 – 10.25	10.50 – 10.75
Boric, crystals	lb.	.12½ – .13	.13½ – .14
Boric, powder	lb.	.13 – .13½	.14 – .14½
Citric	lb.	..... –	.45 – .47
Hydrochloric	100 lb.	1.25 – 1.50	1.60 – 1.75
Hydrofluoric, 52 per cent	lb.	.11½ – .11¾	.12 – .12½
Lactic, 44 per cent tech	lb.	.10 – .11	.11½ – .12
Lactic, 22 per cent tech	lb.	.04½ – .05½	.06 – .07
Molybdic, C. P.	lb.	4.00 – 4.50	4.50 – 5.00
Muriatic, 20 deg. (see hydrochloric)		..... –	..... – .....
Nitric, 40 deg	lb.	.06½ – .06¾	.07 – .07½
Nitric, 42 deg	lb.	.07 – .07¾	.07½ – .07¾
Oxalic, crystals	lb.	.16 – .16½	.17 – .18
Phosphoric, 50 per cent solution	lb.	.13 – .13½	.14 – .18
Picric	lb.	.20 – .25	.27 – .35
Pyrogallic, resublimed	lb.	..... –	1.75 – 1.90
Sulphuric, 60 deg., tank cars	ton	..... –	11.00 – 13.00
Sulphuric, 60 deg., drums	ton	..... –	13.00 – 15.00
Sulphuric, 66 deg., tank cars	ton	18.00 – 20.00	..... – .....
Sulphuric, 66 deg., drums	ton	21.00 – 22.00	22.50 – 23.00
Sulphuric, 66 deg., carboys	ton	..... –	..... – .....
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	21.00 – 22.00	..... – .....
Sulphuric, fuming, 20 per cent (oleum) drums	ton	23.00 – 23.50	24.00 – 24.50
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 – 32.00	33.00 – 34.00
Tannic, U. S. P.	lb.	..... –	.75 – .85
Tannic (tech.)	lb.	.45 – .48	.50 – .55
Tartaric, crystals	lb.	..... –	.27 – .28
Tungstic, per lb. of WO	lb.	..... –	1.30 – 1.40
Alcohol, Ethyl	gal.	..... –	4.65 – 4.90
Alcohol, Methyl (see methanol)		..... –	..... – .....
Alcohol, denatured, 188 proof	gal.	..... –	.35 – .36
Alcohol, denatured, 190 proof	gal.	..... –	.37 – .38
Alum, ammonia lump	lb.	.03½ – .03¾	.04 – .04¼
Alum, potash lump	lb.	.03¾ – .04	.04 – .04½
Alum, chrome lump	lb.	.10 – .11	.11½ – .12½
Aluminum sulphate, commercial	lb.	.02 – .02½	.02½ – .02¾
Aluminum sulphate, iron free	lb.	.03 – .03½	.03½ – .04
Aqua ammonia, 26 deg., drums (750 lb.)	lb.	.07½ – .07¾	.08 – .08½
Ammonia, anhydrous, cyl. (100-150 lb.)	lb.	.30 – .32	.33 – .35
Ammonium carbonate, powder	lb.	.07 – .07½	.08 – .09
Ammonium chloride, granular (white salammoniac)	lb.	.06½ – .06¾	.07 – .07½
Ammonium chloride, granular (gray salammoniac)	lb.	.06½ – .06¾	.07 – .07½
Ammonium nitrate	lb.	.07 – .07¾	.07½ – .08½
Ammonium sulphate	100 lb.	2.20 – 2.25	2.30 – 2.40
Amylacetate	gal.	..... –	3.25 – 3.50
Amylacetate tech	gal.	..... –	2.50 – 3.00
Arsenic oxide, (white arsenic) powdered	lb.	.06½ – .06¾	.07 – .07½
Arsenic, sulphide, powdered (red arsenic)	lb.	.11 – .11¾	.12 – .13
Barium chloride	ton	45.00 – 46.00	47.00 – 50.00
Barium dioxide (peroxide)	lb.	.20 – .21	.22 – .23
Barium nitrate	lb.	.08 – .08¾	.08½ – .09
Barium sulphate (precip.) (blanc fixe)	lb.	.04½ – .04¾	.04½ – .05½
Bleaching powder (see calc. hypochlorite)		..... –	..... – .....
Blue vitriol (see copper sulphate)		..... –	..... – .....
Borax (see sodium borate)		..... –	..... – .....
Brimstone (see sulphur, roll)		..... –	..... – .....
Bromine	lb.	.27 – .28	.28½ – .30
Calcium acetate	100 lbs.	2.00 – 2.05	..... – .....
Calcium carbide	lb.	.04½ – .04¾	.05 – .05½
Calcium chloride, fused, lump	ton	23.50 – 24.00	24.50 – 25.50
Calcium chloride, granulated	lb.	.01½ – .02	.02½ – .02½
Calcium hypochlorite (bleach powder)	100 lb.	2.60 – 2.70	2.80 – 3.25
Calcium peroxide	lb.	..... –	1.40 – 1.50
Calcium phosphate, tribasic	lb.	..... –	.15 – .16
Camphor	lb.	..... –	.73 – .75
Carbon bisulphide	lb.	.06 – .06½	.06½ – .07½
Carbon tetrachloride, drums	lb.	.10½ – .10¾	.11 – .12
Carbonyl chloride (phosgene)	lb.	..... –	.60 – .75
Caustic potash (see potassium hydroxide)		..... –	..... – .....
Caustic soda (see sodium hydroxide)		..... –	..... – .....
Chlorine, gas, liquid cylinders (100 lb.)	lb.	.08 – .09	.09½ – .10
Chloroform	lb.	..... –	.38 – .43
Cobalt oxide	lb.	..... –	2.00 – 2.10
Copperas (see iron sulphate)		..... –	..... – .....
Copper carbonate, green precipitate	lb.	.19 – .19½	.20 – .21
Copper cyanide	lb.	..... –	.50 – .62
Copper sulphate, crystals	lb.	.05½ – .05¾	.05½ – .06
Cream of tartar (see potassium bitartrate)		..... –	..... – .....
Epsom salt (see magnesium sulphate)		..... –	..... – .....
Ethyl Acetate Com. 85%	gal.	..... –	1.00 – 1.10
Ethyl Acetate pure (acetic ether 98% to 100%)	lb.	..... –	.40 – .42
Formaldehyde, 40 per cent	lb.	.12½ – .12¾	.13 – .13½
Fusel oil, ref	gal.	..... –	3.25 – 3.75
Fusel oil, crude	gal.	..... –	1.50 – 1.75
Glauber's salt (see sodium sulphate)		..... –	..... – .....
Glycerine, C. P. drums extra	lb.	..... –	.14 – .14½
Iodine, resublimed	lb.	..... –	3.50 – 3.60
Iron oxide, red	lb.	..... –	.10 – .20
Iron sulphate (copperas)	ton	18.00 – 19.00	20.00 – 21.00
Lead acetate	lb.	..... –	.10½ – .12½
Lead arsenate, paste	lb.	.09 – .09½	.10 – .11
Lead nitrate	lb.	..... –	.15 – .20
Litharge	lb.	.07½ – .08	.08½ – .09
Lithium carbonate	lb.	..... –	1.30 – 1.40
Magnesium carbonate, technical	lb.	.08½ – .09½	.10 – .10½
Magnesium sulphate, U. S. P.	100 lb.	2.40 – 2.75	..... – .....
Magnesium sulphate, technical	100 lb.	..... –	1.05 – 1.60
Methanol, 95%	gal.	..... –	.66 – .68
Methanol, 97%	gal.	..... –	.70 – .72
Nickel salt, double	lb.	..... –	.12 – .12½
Nickel salt, single	lb.	..... –	.14 – .14½
Phosgene (see carbonyl chloride)		..... –	..... – .....
Phosphorus, red	lb.	.40 – .41	.42 – .45
Phosphorus, yellow	lb.	..... –	.30 – .35
Potassium bichromate	lb.	.11½ – .11¾	.12 – .12½

		Carlots	Less Carlots
Potassium bitartrate (cream of tartar)	lb.	$ ... – $....	$0.28½–$0.29½
Potassium bromide, granular	lb.	..... –	.16 – .25
Potassium carbonate, U. S. P.	lb.	.35 – .40	.45 – .50
Potassium carbonate, 80–85%	lb.	.05 – .05½	.06 – .06½
Potassium chlorate, crystals	lb.	.06½– .07	.07½ – .10
Potassium cyanide	lb.	..... –	.26 – .28
Potassium hydroxide (caustic p tash)	lb.	.04½– .04½	.05 – .06
Potassium muriate, 80% K.C.l	ton	42.50 – 45.00	..... – .....
Potassium iodide	lb.	..... –	2.75 – 3.00
Potassium nitrate	lb.	.09¼– .09½	.10 – .12½
Potassium permanganate	lb.	.23 – .24	.24½– .25
Potassium prussiate, red	lb.	.28 – .29	.29½– .30
Potassium prussiate, yellow	lb.	.20½– .21	.22 – .22½
Potassium sulphate (powdered)	per unit	..... –	1.20 – 1.25
Rochelle salts (see sodium potas tartrate)		..... –	..... – .....
Salammoniac (see ammonium chloride)		..... –	..... – .....
Sal soda (see sodium carbonate)		..... –	..... – .....
Salt cake (bulk)	ton	..... –	20.00 – 25.00
Silver cyanide	oz.	..... –	1.35 – 1.38
Silver nitrate	oz.	..... –	.41½– .42
Soda ash, light	100 lb.	2.10 – 2.15	2.20 – 2.70
Soda ash, dense	100 lb.	2.35 – 2.40	2.45 – 2.70
Sodium acetate	lb.	.04 – .04¼	.04½– .05
Sodium bicarbonate	100 lb.	2.25 – 2.40	2.50 – 2.75
Sodium bichromate	lb.	.08 – .08¼	.08½– .09
Sodium bisulphate (nitre cake)	ton	5.00 – 5.25	5.50 – 6.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼– .04½	.05 – .06
Sodium borate (borax)	lb.	.05½– .06	.06½– .07
Sodium carbonate (sal soda)	100 lb.	1.90 – 2.00	2.10 – 2.40
Sodium chlorate	lb.	.07½– .07½	.08 – .08½
Sodium cyanide	lb.	.19½– .21	.22 – .30
Sodium fluoride	lb.	.11 – .11½	.12 – .13
Sodium hydroxide (caustic soda)	100 lb.	3.90 – 4.00	4.10 – 4.60
Sodium hyposulphite	lb.	..... –	.03½– .03¾
Sodium nitrate	100 lb.	2.10 –	2.30 – .....
Sodium nitrite	lb.	.07 – .07½	.07½– .08
Sodium peroxide, powdered	lb.	.25 – .26	.27 – .30
Sodium phosphate, dibasic	lb.	.04½– .04½	.05 – .05½
Sodium potassium tartrate (Rochelle salts)	lb.	..... –	.21 – .24
Sodium prussiate, yellow	lb.	.12¼– .12½	.12½– .13
Sodium silicate, solution (40 deg.)	100 lb.	1.00 – 1.15	1.25 – 1.40
Sodium silicate, solution (60 deg.)	lb.	.02½– .03	.03½– .03¾
Sodium sulphate, crystals (Glauber's salt)	100 lbs.	1.50 – 1.75	2.00 – 2.25
Sodium sulphide, fused, 60–62 per cent (conc.)	lb.	.04½– .04¾	.05 – .06
Sodium sulphite, crystals	lb.	.03½– .04	.04¼– .04½
Strontium nitrate, powdered	lb.	.12 – .12½	.13 – .14
Sulphur chloride, red	lb.	.05 – .05½	.05½– .06½
Sulphur, crude	ton	20.00 –22.00	..... – .....
Sulphur dioxide, liquid, cylinders ex wks.	lb.	.08 – .08½	.09 – .10
Sulphur (sublimed), flour	100 lb.	..... –	2.25 – 3.10
Sulphur, roll (brimstone)	100 lb.	..... –	2.00 – 2.75
Tin bichloride, 50 per cent	lb.	.18 – .19	..... – .....
Tin oxide	lb.	..... –	.38 – .40
Zinc carbonate, precipitate	lb.	.16 – .16½	.17 – .17½
Zinc chloride, gran.	lb.	.09¼– .09½	.10 – .11
Zinc cyanide	lb.	.42 – .44	.45 – .47
Zinc dust	lb.	.11¼– .11½	.11¾– .12½
Zinc oxide, XX	lb.	.07½– .07¾	.08 – .09
Zinc sulphate	100 lb.	3.00 – 3.25	3.30 – 3.50

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude	lb.	$1.10 — $1.15
Alpha-naphthol, refined	lb.	1.25 — 1.30
Alpha-naphthylamine	lb.	.35 — .40
Aniline oil, drums extra	lb.	.18 — .21
Aniline salts	lb.	.25 — .28
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Benzaldehyde U.S.P.	lb.	1.00 — 1.25
Benzidine, base	lb.	1.00 — 1.10
Benzidine sulphate	lb	.75 — .85
Benzoic acid, U.S.P.	lb.	.60 — .65
Benzoate of soda, U.S.P.	lb.	.55 — .60
Benzene, pure, water-white, in drums (100 gal.)	gal.	.27 — .32
Benzene, 90%, in drums (100 gal.)	gal.	.25 — .28
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.50 — 4.00
Beta-naphthol, sublimed	lb.	.70 — .75
Beta-naphthol, tech	lb.	.32 — .35
Beta-naphthyla mine, sublimed	lb.	1.75 — 1.80
Cresol, U. S. P., in drums (100 lb.)	lb.	.16 — .18
Ortho-cresol, in drums (100 lb.)	lb.	.25 — .27
Cresylic acid, 97–99%, straw color, in drums	gal.	.70 — .75
Cresylic acid, 75-97%, dark, in drums	gal.	.60 — .65
Cresylic acid, 50%, first quality, drums	gal.	.45 — .50
Dichlorbenzene	lb.	.06 — .09
Diethylaniline	lb.	1.20 — 1.25
Dimethylaniline	lb.	.43 — .50
Dinitrobenzene	lb.	.26 — .28
Dinitroclorbenzene	lb.	.20 — .30
Dinitronaphthalene	lb.	.30 — .40
Dinitrophenol	lb.	.35 — .40
Dinitrotoluene	lb.	.27 — .30
Dip oil, 25%, car lots, in drums	gal.	.40 — .45
Diphenylamine	lb.	.65 — .70
H-acid	lb.	1.15 — 1.25
Meta-phenylenediamine	lb.	1.15 — 1.20
Monochlorbenzene	lb.	.12 — .14
Monoethylaniline	lb.	1.75 — 1.85
Naphthalene crushed, in bbls.	lb.	.06½— .07½
Naphthalene, flake	lb.	.06½— .08
Naphthalene, balls	lb.	.08 — .09½
Naphthionic acid, crude	lb.	.70 — .75
Nitrobenzene	lb.	.12 — .15
Nitro-naphthalene	lb.	.30 — .35
Nitro-toluene	lb.	.16 — .18
Ortho-amidophenol	lb.	3.10 — 3.20
Ortho-dichlor-benzene	lb.	.15 — .20
Ortho-nitro-phenol	lb.	.80 — .85
Ortho-nitro-toluene	lb.	.15 — .20
Ortho-toluidine	lb.	.20 — .25
Para-amidophenol, base	lb.	1.40 — 1.45
Para-amidophenol, HCl	lb.	1.60 — 1.75
Para-dichlorbenzene	lb.	.15 — .20
Paranitroaniline	lb.	.75 — .80
Para-nitrotoluene	lb.	.85 — .95
Para-phenylenediamine	lb.	1.70 — 1.75
Para-toluidine	lb.	1.25 — 1.40
Phthalic anhydride	lb.	.50 — .60
Phenol, U. S. P., drums	lb.	.08½— .10
Pyridine	gal.	2.00 — 3.50
Resorcinol, technical	lb.	1.60 — 1.65
Resorcinol, pure	lb.	2.25 — 2.30
Salicylic acid, tech., in bbls.	lb.	.19 — .22
Salicylic acid, U. S. P.	lb.	.20 — .25
Salol	lb.	.60 — .75
Solvent naphtha, water-white, in drums, 100 gal.	gal.	.25 — .28
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal.	.14 — .16
Sulphanilic acid, crude	lb.	.27 — .30
Tolidine	lb.	1.25 — 1.35
Toluidine, mixed	lb.	.40 — .45
Toluene, in tank cars	gal.	.25 — .28
Toluene, in drums	gal.	.28 — .31
Xylidines, drums, 100 gal.	lb.	.40 — .45
Xylene, pure, in drums	gal.	.40 — .45
Xylene, pure, in tank cars	gal.	.45 — ....
Xylene, commercial, in drums, 100 gal.	gal.	.33 — .35
Xylene, commercial, in tank cars	gal.	.30 — ....

Waxes

Prices based on original packages in large quantities.

Beeswax, refined, dark	lb.	$0.24 — $0.25
Beeswax, refined, light	lb.	.28 — .30
Beeswax, white pure	lb.	.36 — .42
Candelilla wax	lb.	.25 — .26
Carnauba, Flora	lb.	.48 — .50
Carnauba, No. 2, North Country	lb.	.25 — .26
Carnauba, No. 3, North Country	lb.	.14½— .15
Japan	lb.	.24 — .25
Montan, crude	lb.	.06½— .06½
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.03½— .03½
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02 — ....
Paraffine waxes, refined, 118-120 m.p.	lb.	.03 — .03½
Paraffine waxes, refined, 125 m.p.	lb.	.03½— .03½
Paraffine waxes, refined, 128-130 m.p.	lb.	.03½— .04¼
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½— .05
Paraffine waxes, refined, 135-137 m.p.	lb.	.05½— .06
Stearic acid, single pressed	lb.	.09½— ....
Stearic acid, double pressed	lb.	.10½— ....
Stearic acid, triple pressed	lb.	.11 — .11½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl.	280 lb.	$5.25 —	5.30
Rosin E-I	280 lb.	5.30 —	5.40
Rosin K-N	280 lb.	5.55 —	5.70
Rosin W. G.-W. W.	280 lb.	6.60 —	7.35
Wood rosin, bbl.	280 lb.	6.25 —	.....
Spirits of turpentine	gal.	.68 —	.....
Wood turpentine, steam dist.	gal.	.66 —	.....
Wood turpentine, dest. dist.	gal.	.64 —	.....
Pine tar pitch, bbl.	200 lb.	..... —	7.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	..... —	11.00
Retort tar, bbl.	500 lb.	—	11.00
Rosin oil, first run	gal.	.35 —	.....
Rosin oil, second run	gal.	.37 —	.....
Rosin oil, third run	gal.	.44 —	.....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		$1.90
Pine oil, pure, dest. dist.	gal.		1.50
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.35
Turpentine, crude, sp. gr., 0.900-0.970	gal.		1.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.35
Pinewood creosote, ref.	gal.		.52

Solvents

73-76 deg., steel bbls. (85 lb.)	gal.	$0.37
70-72 deg., steel bbls. (85 lb.)	gal.	.35
68-70 deg., steel bbls. (85 lb.)	gal.	.34
V. M. and P. naphtha, steel bbls. (85 lb.)	gal.	.23

Crude Rubber

Para—Upriver fine	lb.	$0.16 —	.17
Upriver coarse	lb.	.09 —	.09½
Upriver caucho ball	lb.	.11½ —	.12
Plantation—First latex crepe	lb.	.14 —	.....
Ribbed smoked sheets	lb.	.12 —	.12½
Brown crepe, thin, clean	lb.	.15 —	.....
Amber crepe No. 1	lb.	.17 —	.....

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls.	lb.	$0.09½ —	$0.09½
Castor oil, AA, in bbls.	lb.	.10½ —	.11
China wood oil, in bbls. (f.o.b. Pac. coast)	lb.	.11 —	.11½
Cocoanut oil, Ceylon grade, in bbls.	lb.	.10 —	.10½
Cocoanut oil, Cochin grade, in bbls.	lb.	.10½ —	.11½
Corn oil, crude, in bbls.	lb.	.08½ —	.08½
Cottonseed oil, crude (f. o. b. mill)	lb.	.08 —	.08½
Cottonseed oil, summer yellow	lb.	.10 —	.10½
Cottonseed oil, winter yellow	lb.	.10½ —	.11
Linseed oil, raw, car lots (domestic)	gal.	.73 —	.74
Linseed oil, raw, tank cars (domestic)	gal.	.67 —	.68
Linseed oil, in 5-bbl lots (domestic)	gal.	.75 —	.76

Olive oil, Denatured	gal.	$1.10 —	$1.20
Palm, Lagos	lb.	.07½ —	.08
Palm, Niger	lb.	.07½ —	.07⅝
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.07½ —	.08
Peanut oil, refined, in bbls	lb.	.10½ —	.10¾
Rapeseed oil, refined in bbls	gal.	.86 —	.88
Rapeseed oil, blown, in bbls	gal.	.92 —	.94
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.08½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.06½ —	....
FISH			
Light pressed menhaden	gal.	$0.40 —	....
Yellow bleached menhaden	gal.	.42 —	....
White bleached menhaden	gal.	.44 —	....
Blown menhaden	gal.	.48 —	....

Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	$24.00 —	30.00
Barytes, ground, off color, f.o.b. Kings Creek	net ton	22.00 —	26.00
Barytes, crude, 88%@94% ba., Kings Creek	net ton	10.00 —	12.00
Barytes, floated, f.o.b. St. Louis	net ton	23.00 —	24.00
Barytes, crude, first grade, Missouri	net ton	7.00 —	....
Blanc fixe, dry	lb.	.04 —	.04½
Blanc fixe, pulp	net ton	45.00 —	55.00
Casein	lb.	.06½ —	.07½
Chalk, Precipitated, domestic, extra light	lb.	.04½ —	.05
Chalk, Precipitated, domestic, light	lb.	.04 —	.04½
Chalk, Precipitated, domestic, heavy	lb.	.03½ —	.04
Chalk, Precipitated, English, extra light	lb.	.04½ —	.05
Chalk, Precipitated, English, light	lb.	.04½ —	.05
Chalk, Precipitated, English, dense	lb.	.04 —	.04½
China clay (kaolin) crude, f.o.b. mines, Georgia	net ton	6.50 —	8.50
China clay (kaolin) washed, f.o.b. Georgia	net ton	9.00 —	10.00
China clay (kaolin) powdered, f.o.b. Georgia	net ton	13.00 —	20.00
China clay (kaolin) crude f.o.b. Virginia points	net ton	8.00 —	12.00
China clay (kaolin) ground, f.o.b. Virginia points	net ton	13.00 —	20.00
China clay (kaolin), imported, lump	net ton	12.00 —	20.00
China clay (kaolin), imported, powdered	net ton	25.00 —	30.00
Feldspar, crude, f.o.b. Maryland and North Carolina points	net ton	5.00 —	7.50
Feldspar, crude, f.o.b. Maine	net ton	7.50 —	10.00
Feldspar, ground, f.o.b. Maine	net ton	21.00 —	23.00
Feldspar, ground, f.o.b. North Carolina	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. N. Y. State	net ton	17.00 —	21.00
Feldspar, ground, f.o.b. Baltimore	net ton	27.00 —	30.00
Fullers earth, f.o.b. Mines	net ton	16.00 —	17.00
Fullers earth, granular, f.o.b. Pa	net ton	15.00 —	16.00
Fullers earth, powdered, f.o.b. Fla	net ton	18.00 —	....
Fullers earth, imported, powdered	net ton	24.00 —	27.00
Graphite, Ceylon lump, first quality	lb.	.06 —	.07
Graphite, Ceylon chip	lb.	.04½ —	.05
Graphite, high grade amorphcus crude	lb.	.00½ —	.02½
Kieselguhr, f.o.b. mines, Cal	per ton	40.00 —	....
Kieselguhr f.o.b. N.Y.	per ton	61.00 —	....
Magnesite, calcined	per ton	66.00 —	70.00
Pumice stone, imported, lump	lb.	.03 —	.40
Pumice stone, domestic lump	lb.	.05 —	.05½
Pumice stone, ground	lb.	.06 —	.07
Quartz (acid tower) first to head, f.o.b. Baltimore	net ton	..... —	10.00
Quartz (acid tower) 1½@2 in., f.o.b. Baltimore	net ton	..... —	14.00
Quartz (acid tower) rice, f.o.b. Baltimore	net ton	..... —	17.00
Quartz, lump, f.o.b. North Carolina	net ton	5.00 —	7.50
Shellac, orange fine	lb.	.52 —	.53
Shellac, orange superfine	lb.	.55 —	.56
Shellac, A. C. garnet	lb.	.44 —	.45
Shellac, T. N.	lb.	.45 —	.46
Soapstone	ton	12.00 —	15.00
Sodium chloride	long ton	12.50 —	13.00
Talc, paper-making grades, f.o.b. Vermont	ton	11.00 —	18.00
Talc, roofing grades, f.o.b. Vermont	ton	8.50 —	13.00
Talc, rubber grades, f.o.b. Vermont	ton	11.00 —	18.00
Talc, powdered, Southern, f.o.b. cars	ton	10.00 —	14.00
Talc, imported	ton	30.00 —	40.00
Talc, California talcum powder grade	ton	18.00 —	40.00

Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh	per ton	$37.50–40.00	
Carborundum refractory brick, 9-in.	less than carlot	1,000	1250.00
	carload lots	1,000	1100.00
Chrome brick, f.o.b. Eastern shipping points	net ton	60	
Chrome cement, 40–45% Cr_2O_3	net ton	30– 32	
Chrome cement, 40–45% Cr_2O_3, sacks, in car lots, f.o.b. Eastern shipping points	net ton	33– 35	
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	36– 40	
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works	1,000	30– 35	
Magnesite brick, 9-in. straight	net ton	70	
Magnesite brick, 9-in. arches, wedges and keys	net ton	77	
Magnesite brick, soaps and splits	net ton	98	
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	42– 45	
Silica brick, 9-in. sizes, f.o.b. Birmingham district	1,000	46– 50	
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa	1,000	35– 38	

Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225.00
Ferrochrome per lb. of Cr. contained, 6–8% carbon, carlots	lb.	.12 —	....
Ferrochrome, per lb. of Cr. contained, 4-6% carbon, carlots	lb.	.13 —	....
Ferromanganese, 76-80% Mn, domestic	net ton	65.00 —	67.00
Ferromanganese, 76-80% Mn, English	net ton	65.00 —	67.00
Spiegeleisen, 18-22% Mn	net ton	25.00 —	27.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.50 —	....
Ferrosilicon, 10-15%	net ton	38.00 —	40.00
Ferrosilicon, 50%	net ton	60.00 —	65.00
Ferrosilicon, 75%	net ton	130.00 —	135.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.40 —	.45
Ferrouranium, 35-50% of U, per lb. of U content	lb.	6.00 —	....
Ferrovanadium, 30-40% per lb. of contained V.	lb.	4.25 —	4.50

Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content	net ton	$8.00 —	$10.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	unit	.27 —	.30
Chrome ore, 50% Cr_2O_3, f.o.b. Atlantic seaboard	unit	.27 —	.30
Coke, foundry, f.o.b. ovens	net ton	4.25 —	4.50
Coke, furnace, f.o.b. ovens	net ton	3.00 —	3.25
Coke, petroleum, refinery, Atlantic seaboard	net ton	14.00 —	15.00
Fluorspar, lump, f.o.b. mines, New Mexico	net ton	12.50 —	....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	20.00 —	22.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½ —	.01¾
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.20 —	.21
Manganese ore, chemical (MnO_2)	net ton	50.00 —	55.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.55 —	.60
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	unit	30.00 —	....
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.12 —	.12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.12 —	.12
Pyrites, domestic, fines, f.o.b. mines, Ga	unit	.11 —	.12
Rutile, 95% TiO_2 per lb. ore	lb.	.15 —	....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	2.75 —	3.00
Tungsten, Wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	3.00 —	3.25
Uranium ore (carnotite) per lb. of U_3O_8	lb.	1.50 —	2.50
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	....
Zircon, washed, iron free	lb.	.03 —	....

Non-Ferrous Metals

New York Markets

	Cents per Lb.
Copper, electrolytic	12.00@12.25
Aluminum, 98 to 99 per cent	24.5@25
Antimony, wholesale lots, Chinese and Japanese	4¼@4½
Nickel, ordinary (ingot)	41.00
Nickel, electrolytic	44.00
Monel metal, shot and blocks	35.00
Monel metal ingots	38.00
Monel metal, sheet bars	40.00
Tin, 5-ton lots, Straits	27.00
Lead, New York, spot	4.40
Lead, E. St. Louis, spot	4.20@4.25
Zinc, spot, New York	4.50@4.55
Zinc, spot, E. St. Louis	4.15@4.20

OTHER METALS

Silver (commercial)	oz.	$0.63½
Cadmium	lb.	1.00–1.25
Bismuth (500 lb. lots)	lb.	1.50@1.55
Cobalt	lb.	3.00@3.25
Magnesium (f.o.b. Philadelphia)	lb.	1.25
Platinum	oz.	75.00@78.00
Iridium	oz.	160.00@170.00
Palladium	oz.	55.00–60.00
Mercury	75 lb.	43.50–45.00

FINISHED METAL PRODUCTS

	Warehouse Price Cents per Lb.
Copper sheets, hot rolled	19.75@20.00
Copper bottoms	27.25@27.50
Copper rods	18.50@19.00
High brass wire	16.75
High brass rods	13.75
Low brass wire	18.25
Low brass rods	18.25
Brazed brass tubing	27.00
Brazed bronze tubing	31.75
Seamless copper tubing	20.00
Seamless high brass tubing	18.50

OLD METALS—The following are the dealers' purchasing prices in **cents** per pound:

	New York Current	Cleveland	Chicago
Copper, heavy and crucible	9.00@ 9.25	9.25	9.50
Copper, heavy and wire	8.25@ 8.50	8.50	8.50
Copper, light and bottoms	7.00@ 7.25	7.50	7.25
Lead, heavy	3.00@ 3.25	3.25	3.25
Lead, tea	2.25@ 2.35	2.25	2.25
Brass, heavy	4.00@ 4.25	4.50	5.00
Brass, light	3.00@ 3.25	3.25	3.50
No. 1 yellow brass turnings	3.75@ 4.00	4.25	4.50
Zinc	2.00@ 2.25	2.00	2.25

Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

	New York	Cleveland	Chicago
Structural shapes	$2.88	$2.88	$2.88
Soft steel bars	2.78	2.78	2.78
Soft steel bar shapes	2.78	2.78	2.78
Soft steel bands	3.42	3.48	3.48
Plates, ¼ to 1 in. thick	2.88	2.80	2.80

*Add 15c per 100 lb. for trucking to Jersey City and 10c for delivery in New York and Brooklyn

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

Alabama

GOODWATER—The Flake Graphite Corp. is planning for the rebuilding of its local plant destroyed by fire, Aug. 23, with loss estimated at close to $500,000, including refining and other machinery.

California

LOS ANGELES—The Western Chemicals Co., 503 Merchants' National Bank Bldg., has plans under way for the construction of a new plant at San Pedro Harbor, comprising a main building, 40 x 200 ft., with wing extensions 40 x 100 ft. Headquarters of the company are at Tonapah, Nev.

LONG BEACH—The Fredonia Window Glass Co., Fredonia, Kan., is considering the erection of a new glass-manufacturing plant on site selected at Long Beach. Plans are under way and construction will be commenced at an early date. The local Chamber of Commerce, George A. Brown, secretary, is interested in the project. C. F. Lutz is president and general manager of the company.

LONG BEACH—The Shell Oil Co. has completed plans for the construction of a number of new mechanical buildings at its plant in the Signal Hill section, to be located on Obispo Ave. The structures are estimated to cost $51,000 and will comprise a machine works, 52 x 75 ft.; forge shop 52 x 60 ft.; mechanical shop and warehouse 76 x 90 ft., and other miscellaneous buildings.

Connecticut

NEW HAVEN—The Star Paper Co. will rebuild the portion of its plant, destroyed by fire Aug. 13, with loss reported at about $12,000.

MANCHESTER—The Oxford Soap Co., Hilliard St., has filed plans for the construction of a 1-story addition to its plant, about 14 x 100 ft.

HARTFORD—The United States Envelope Co., 248 Pearl St., will commence the immediate erection of a new 4-story plant addition, estimated to cost about $50,000. Contract for construction has recently been let to the Casper Ranger Construction Co., 20 Bond St., Holyoke, Mass.

Florida

PUNTA GORDA—The Southern Tanning & Mfg. Co., recently organized, is planning for the establishment of a local tannery for the production of high-grade leather products.

OCALA—The Sure Shot Timber Killer Co., recently organized to manufacture chemical products for the destruction of timber growths, weeds, etc., has plans under way for the establishment of a new local plant for the manufacture of its products. A local building has been leased for the works. E. H. Hopkins, Reddick, Fla., is president.

Georgia

BRUNSWICK—The Industrial Chemical & Fertilizer Co., recently incorporated, is planning for the construction of a new 1-story plant, 100 x 100 ft., to be equipped for the manufacture of fertilizer products. B. S. Brown is general manager.

Illinois

CHICAGO—E. F. Houghton & Co., 3524 Shields Ave., manufacturer of refined oil products, with main plant at Philadelphia, Pa., has filed plans for the construction of a new 1-story building, 30 x 100 ft., at its local works. The Austin Co., 208 South La Salle St., has the erection contract.

Louisiana

NEW ORLEANS—The Jefferson Distilling & Denaturing Co. is planning for the reconstruction of its local plant building, destroyed by fire Aug. 24, with loss estimated in excess of $50,000, including equipment and stock.

NEW ORLEANS—The Colonial Chemical Corp., Reading, Pa., manufacturer of chemical compounds, disinfectants, etc., has leased a building at New Orleans for the establishment of a new branch works. George Bowman, secretary, will represent the company in this section.

Maryland

BALTIMORE—The Canton Co. has filed plans for the construction of a new plant on O'Donald St. near Third St. for the manufacture of lard and kindred products, consisting of a main 4-story building, 72 x 114 ft., and two 1-story structures, 50 x 58 ft., and 33 x 50 ft., respectively. The new plant will cost about $75,000.

BALTIMORE—The American Sugar Refining Co. has filed plans for a 1-story building, 72 x 138 ft., at its new refinery, now in course of erection. The structure will be used for general manufacturing purposes, and will be located at Clement and Woodall Sts.

ARBUTUS—The Adamantex Brick Co. has construction under way on a new 2-story plant, 162 x 268 ft., to be equipped for the manufacture of sand-lime brick under a special process. The company has a tract of about 50 acres of property for its plant site and as a source of raw materials. The works will be equipped for a daily output of about 100,000 bricks, composed of sand, portland cement and a special chemical binder. Louis F. Drucker is president; and George B. Clemmert, 416 North Howard St., Baltimore, secretary and treasurer.

Michigan

HOLLAND—The DePree Chemical Co. has completed plans and will soon commence the erection of a new 2-story and basement building at its plant, 60 x 140 ft., estimated to cost about $15,000.

Mississippi

GULFPORT—Charles T. Madison and George S. Dodds, Gulfport, are organizing a new company to construct an oil refinery on local site with daily output of about 300 bbl. of material.

Missouri

ST. LOUIS—The Standard Stamping Co., 2000 North Broadway, manufacturer of stamped metal products, has awarded a contract to the A. H. Haessler Contracting Co., Wainwright Bldg., for the erection of a new 1-story plant at Broadway and Madison St., 107 x 135 ft., to be equipped as an enameling works. George Weigand is president.

WACO—The American Zinc, Lead & Smelting Co., Pierce Bldg., St. Louis, Mo., has acquired the property of the High Five Mining Co. at Waco, for a consideration said to be $250,000. The new owner plans to develop the site with installation of mining and other equipment.

KANSAS CITY—The Kelly Mill Co., Rochester and Park Aves., is reported to be planning for the rebuilding of its flour mill at location noted, recently destroyed by fire with loss reported in excess of $250,000. A. B. Kelly is president.

Nebraska

ANTIOCH—The plant and equipment of the Alliance Potash Co. has been purchased by Herman J. Krause, who has been interested in the company, at a sheriff's sale, for a consideration said to be $32,600. The plant was constructed about four years ago at a cost of close to $500,000, including machinery. The new owner will reorganize the company and operate the works.

New Jersey

GLOUCESTER CITY—The Argo Paper Mills Corp. has been incorporated under Delaware laws with a capital of $3,000,000, to operate a local plant for the manufacture of newsprint and other paper products. The company will take over the former Argo Mills plant at this place, previously used for the manufacture of textile products, and Frank J. Hummell, the owner of the property, heads the new organization. The works will be remodeled to accomodate the new industry and equipment installed at an early date.

NEWARK—The Celluloid Co., 290 Ferry St., will take bids at once for the construction of a new 1-story building, 72 x 210 ft., located at Niagara and Westcott Sts., estimated to cost about $200,000. The J. G. White Co., 43 Exchange Pl., New York, is architect and engineer.

New York

OGDENSBURG—The Bob White Chemical Co., formerly known as the Morgan Chemical Co., is planning for the construction of a new laboratory and other buildings at its plant.

CADYVILLE—The International Paper Co., 30 Broad St., New York, N. Y., has commenced the construction of a new hydro-electric power plant on the Saranac River, near Cadyville, estimated to cost about $250,000. It will be used for paper mill operations in this district.

TROY—The Hercules Powder Co. is planning for the rebuilding of the portion of its plant at Schaghticoke, near Troy, recently destroyed by fire.

Ohio

ROSEVILLE—The T. S. Lowry Pottery Co. has completed plans for the erection of a new 1-story plant addition, 60 x 135 ft., estimated to cost about $35,000. Construction will be commenced at an early date. N. I. Tycer is president.

DAYTON—The Allsteel Ridewell Tire & Rubber Co., 513 Lindsay Bldg., has completed plans for the erection of its proposed new plant on South Dayton St., to be 3-story and basement, 125 x 300 ft., and estimated to cost about $500,000 with machinery.

YOUNGSTOWN—The Wells Process Co., Youngstown, is taking bids for the erection of a new plant at Conneaut, O., to be 1-story, 60 x 108 ft., and estimated to cost about $25,000. Ralph Wells of the Wells Mfg. Co., Youngstown, heads the company.

Oklahoma

OKLAHOMA CITY—The Choate Oil Corp. is planning for enlargements in its oil refinery to increase the daily output from 2,500 to 3,000 bbl.

Pennsylvania

ECONOMY—The Wyckoff Drawn Steel Co., Frick Bldg., Pittsburgh, Pa., has completed plans for the erection of a 1-story addition to its plant at Economy, Pa., to be 60 x 240 ft.

PITTSBURGH—The Air Reduction Co., 120 Broadway, New York, has commissioned Architects Francisco & Jacobus, 511 Fifth Ave., New York, to prepare plans for its proposed new oxygen-manufacturing plant on property recently acquired on Ridge Ave., Pittsburgh, to be 1- and 2-story, 80 x 140 ft., and estimated to cost close to $250,000 with equipment.

PHILADELPHIA—The General Smelting Co., Stock Exchange Bldg., has awarded a contract to H. E. Baton, 1713 Sansom St., for the erection of its proposed new 1-story plant at Bath and Westmoreland Sts., 60 x 100 ft., to be used for chemical service.

Tennessee

KNOXVILLE—The Pure Paint & Varnish Co., recently organized with a capital of $150,000, has plans under way for the erection of a new 3-story plant on local site for the manufacture of paint, varnish and kindred products. It is estimated to cost about $40,000. J. C. Trewitt, Knoxville, is vice-president in charge. J. R. Lee, Sparta, Tenn., is president.

CHATTANOOGA—The plant of the New Citico Brick Co. has been acquired by H. G. Fleming, J. J. Wall and associates. The new owners are planning for the erection of an addition to double the present output, approximating 40,000 bricks a day.

Texas

WAXAHACHIE—The new oil refinery to be constructed by the Texas Oil Products Co., initial work for which is under way, will comprise the second unit of the company's local plant. The first unit is now in operation under a 24-hour period, with output rated at 500 bbl. per day. The new extension will have a like capacity.

WILLS POINT—The Van Zandt Cotton Oil Co., recently incorporated with a capital of $600,000, is planning for the erection of a local plant for the manufacture of cottonseed oil and byproducts. W. P. Allen heads the company.

New Companies

THE ANSONIA CHEMICAL CO., New York, N. Y. has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are W. S. Perry, F. S. Mordaunt and L. Sterns. The company is represented by DeWitt & Mulqueen, 111 Broadway.

THE CARBOLOID PRODUCTS CORP., Jersey City, N. J., has been incorporated with a capital of $20,000, to manufacture composition specialties. The incorporators are William E. Barddusch, Emil W. A. Schumann and William H. Carey, 1 Montgomery St.

THE BECKER PAPER CO., Springfield, Mass., has been incorporated with a capital of $50,000, to manufacture paper goods. Earl Becker, Springfield, is president and Edward M. Miller, treasurer.

THE MYSTIC GLASS CO., Los Angeles, Cal., has been incorporated with a capital of $300,000, to manufacture glass products. The incorporators are John V. Hoffman, LeVerne Fox and George D. Hussey. The company is represented by David P. Hatch, Room 1121 I. N. Van Nuys Bldg.

THE FIBROUS MFG. CO., 130 Market St., Newark, N. J., has filed notice of organization to manufacture fiber products. The company is represented by Elwood B. Hendricks, 645 Springdale Ave., East Orange, N. J.

THE CALUMET CHEMICAL CO., 4100 Fillmore St., Chicago, Ill., has been incorporated with a capital of $50,000, to manufacture chemicals and chemical byproducts. The incorporators are F. O. Mason, P. Lee and Raymond S. Pruitt.

THE MCRAE STEEL CO., Detroit, Mich., has been incorporated with a capital of $30,000, to manufacture steel products. The incorporators are Herbert C. Shotwell, D. Shepard Shine, Jr., and Kenneth C. McRae, 2714 Pingree Ave.

THE DEFIANCE PAINT PRODUCTS CO., INC., South River, N. J., has been incorporated with a capital of $500,000, to manufacture paints, varnishes and kindred products. The incorporators are Benjamin W. Moreland, John H. Sloan and Matthew H. Loughridge, South River.

THE RIDDLE MFG. CO., Jacksonville, Fla., has been incorporated with a capital of $25,000, to manufacture chemicals, and chemical byproducts. J. R. Crosby is president; W. H. McGee, vice-president; and G. B. McDaniel, secretary-treasurer, all of Jacksonville.

THE FRENCH QUALITY TOILET SOAP MFG. CO., Brooklyn, N. Y., has been incorporated with a capital of $40,000, to manufacture soaps and affiliated products. The incorporators are G. R. Hall, M. L. Gilman and C. Steiner. The company is represented by C. S. Sachs, 119 Nassau St., New York.

THE DUSTBANE PRODUCTS CO., 3629 South Ashland Ave., Chicago, Ill., has been incorporated with a nominal capital of $5,000, to manufacture sweeping compounds and other chemical products. The incorporators are M. B. Woodrich, Daniel Burkhartsmeier and G. A. Gillmurry.

THE GOLDEN STATE COLOR & CHEMICAL WORKS, Obispo Ave., Long Beach, Cal., has filed notice of organization to manufacture chemicals and affiliated products. James V. Nevin, 2817 East Second St., Long Beach, heads the company.

THE METAL GOODS MFG. CO., Boston, Mass., has been incorporated with a capital of $100,000, to manufacture metal products. Ralph C. Heath, 267 Washington St., Melrose, Mass., is president and treasurer.

THE GORTON PAPER CORP., Bridgeport, Conn., has been incorporated with a capital of $50,000, to manufacture paper goods. The incorporators are C. W. Gorton, N. P. Bump and C. T. Appleton, 45 Curtis Ave.

THE PENN SHOPE BRICK CO., Reading, Pa., has been incorporated with a capital of $50,000, to manufacture brick and other burned clay products. A. F. Kostenbader, Reading, is treasurer.

THE STELLAR CHEMICAL CO., New York, N. Y., has been incorporated with a capital of $20,000, to manufacture chemicals and chemical byproducts. The incorporators are H. S. Leman, A. M. Lee and H. M. Schechter. The company is represented by H. N. Wessel, 45 Cedar St.

THE SANDY CREEK OIL CO., Port Arthur, Tex., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are A. V. McFadden and F. C. Pfeiffer, Port Arthur.

THE JORDON SPECIALTY CO., Tampa, Fla., has been incorporated with a capital of $10,000, to manufacture chemicals and chemical byproducts. Leo B. Jordon is president; A. T. Jordon, vice-president; and P. T. Jordon, secretary and treasurer, all of Tampa.

THE RELIABLE JAPANNING CO., INC., Newark, N. J., has been incorporated with a capital of $25,000, to manufacture japanned metal goods, electroplated wares, etc. The incorporators are Frank Principe, Peter and Walter F. Lynch, 14 Ferdon St.

THE ROTARY OIL CO., Los Angeles, Cal., has been incorporated with a capital of $200,000, to manufacture petroleum products. The incorporators are James M. Ross, William H. Yerian and W. G. Purser. The company is represented by Peyton H. Moore, 915 Black Bldg.

THE CLARK PAPER TUBE CO., Huntington, W. Va., has been incorporated with a capital of $50,000, to manufacture paper products. The incorporators are George G. Clark and G. F. Templeman, Huntington.

THE MIDDLESEX OIL CORP., Perth Amboy, N. J., has been incorporated with a capital of $125,000, to manufacture refined oil products. The incorporators are Samuel Sedersky and Oliver H. Brown. The company is represented by Joseph E. Stricker, 117 Smith St.

THE CONSOLIDATED OIL PRODUCERS, INC., Los Angeles, Cal., has been incorporated with a capital of $1,500,000, to manufacture petroleum products. The incorporators are T. S. Trebell, Harvey A. Young and Irving V. Auger. The company is represented by James E. Kelby, 929 W. P. Story Bldg.

THE STANDARD STEEL CO., Detroit, Mich., has been incorporated with a capital of $10,000, to manufacture steel products. The incorporators are Julius G. and Samuel B. Solomon, 220 Elmhurst Ave., Highland Park, Detroit.

THE J. & M. BRICK CO., 903 Boundry Ave., Los Angeles, Cal., has filed notice of organization to manufacture brick and other burned clay products. The company is headed by D. B. Jeffries, 1818 West 49th St.

THE RUBBER SERVICE CO., South River, N. J., has been incorporated with a capital of $50,000, to manufacture rubber goods. The incorporators are Anders K. White, Chester R. Holman and Herman W. Ritter, South River.

THE GIBSON OIL CO., Vincennes, Ind., has been incorporated with a capital of $250,000, to manufacture petroleum products. The incorporators are A. W. Keith, J. M. England and W. F. Farrell, Vincennes.

THE NEW YORK PAINT REMOVER & MOTOR CLEANING CO., INC., New York, N. Y., has been incorporated with a capital of $100,000, to manufacture chemical specialties, cleaning compounds, etc. The principal incorporator is W. A. Craddock, 10 West 61st St.

THE MARSHALL-PRESTON OIL PRODUCING & MFG. CO., Cameron, W. Va., has been incorporated with a capital of $50,000, to manufacture petroleum products. The incorporators are C. E. Plummer and G. T. Logsdon, Newburg, W. Va.

JAMES A. ROSS, INC., Boston, Mass., has been incorporated with a capital of $100,000, to manufacture chemicals and affiliated products. James A. Ross, 1 Canal St., Lawrence, Mass., is president and treasurer.

THE WHITE STAR OIL CO., Monroe, La., has been incorporated with a capital of $100,000, to manufacture refined oil products. Henry Burnstein is president; Allan Sholars, vice-president; and John J. Potts, secretary and treasurer, all of Monroe.

THE OKLAHOMA LUBRICATING OIL CO., Oklahoma City, Okla., has been incorporated under Delaware laws, with capital of $400,000, to manufacture lubricating and other refined oils. The company is represented by the Corporation Trust Co., of America, Du Pont Bldg., Wilmington, Del.

THE PENLAND FELDSPAR & KAOLIN CO., Penland, N. C., has been incorporated with a capital of $25,000, to operate feldspar and clay properties. The incorporators are Charles R. Harry and L. P. Bailey, all of Penland, N. C.

HENCHY & FITZSIMMONS, INC., New York, N. Y., has been incorporated with a capital of $15,000, to manufacture chemical specialties. The incorporators are R. F. Henry, J. J. Flood and G. F. Maguire, 149 Broadway.

THE TRIANGLE CHEMICAL CO. has been organized in Vancouver, B. C., to manufacture hydrochloric acid, sulphuric acid, superphosphates, and fertilizers generally. The company has arranged with the city of New Westminster for a lease of land on the waterfront of the Northwest arm, where a plant is to be erected.

THE SHRIVER OIL CO., Westminster, Md., has been incorporated with a capital of $50,000, to manufacture refined oil products. The incorporators are Robert T., R. S. and William H. Shriver, Westminster.

THE CARONI PRODUCTS CO., New York, N. Y., has been incorporated with a capital of $100,000, to manufacture flavoring extracts, alcohol byproducts, etc. The incorporators are H. J. Terwilliger, E. R. Whittingham and W. C. Blach. The company is represented by Stockton & Stockton, 2 Rector St., New York.

THE PACIFIC MINERALS & CHEMICAL CO., INC., New York, N. Y., has been incorporated under Delaware laws, with a capital of $10,000,000, to manufacture chemicals, chemical byproducts and kindred specialties. The company is represented by Arthur W. Briton, 65 Cedar St.

THE OHIO-KENTUCKY FLUORSPAR & LEAD CORP., Smithland, Ky., has been incorporated with a capital of $1,000,000, to operate fluorspar and lead properties, lead refining plants, etc. The incorporators are F. B. Moddle, Smithland; and Thomas J. Clay, White Castle, La.

Capital Increases, Etc.

THE OWEGO MFG. CO., Owego, N. Y., has been merged with the Wilbur White Chemical Co., Owego, under the latter name.

THE APONA CHEMICAL CO., South Bend, Ind., has filed notice of dissolution under state laws.

THE KLEYENSTEUBER-WHITE FOUNDRY CO., Birmingham, Ala., manufacturer of metal castings, has increased its capital to $20,000. M. G. Kleyensteuber is president.

THE NEW JERSEY CAR SPRING & RUBBER CO., 91 Brunswick St., Jersey City, N. J., has filed a petition in bankruptcy. The assets and liabilities have not been stated.

THE WOLVERINE PETROLEUM CO., Saginaw, Mich., has filed notice of increase in capital from $50,000 to $250,000.

THE GLIDDEN CO., Cleveland, O., manufacturer of paints, varnishes, etc., has arranged for a bond issue of $3,350,000. Adrian D. Joyce is president.

THE CORSICANA PETROLEUM CO., Houston, Tex., has filed notice of increase in capital from $20,000 to $80 000. J. H. Farber is president.

THE LAWTON REFINING CO., Lawton, Okla., manufacturer of refined petroleum products, has filed notice of increase in capital from $100,000 to $150,000.

THE LIMETON LIME CO., Front Royal, Va., manufacturer of lime products, has filed notice of increase in capital from $20,000 to $50,000. R. E. Herr is president.

THE SALT SPRINGS SOLAR COARSE SALT CO., Syracuse, N. Y., has filed notice of reduction in capital from $120,000 to $24,000.

Manufacturers' Catalogs

THE CONVEYORS CORPORATION OF AMERICA, Chicago, Ill., has issued a booklet, "The Proof of the Pudding," which consists of 70 testimonial letters received from users of its conveyors. Copies will be sent on application.

THE YALE & TOWNE MFG. CO., Stamford, Conn., has issued two leaflets. The first is on "Electric Industrial Trucks, Model A-17 Crane Truck" and the second on "Electric Industrial Trucks, Model C-6-36 Trailer." Illustrations and specifications are given.

THE YORK MFG. CO., York, Pa., calls attention to Bulletin 10a, which supersedes Bull. 10, on ice-making and refrigerating machinery.

THE ATLAS VALVE CO., Newark, N. J., calls attention to Bulletin 5, entitled "Victor Damper Regulator No. 3, High Pressure." This regulator is designed for boiler pressures up to 250 lb.

THE NASH ENGINEERING CO., South Norwalk, Conn., has published a catalog covering Jennings hytor return line vacuum and low pressure boiler feed pumps. This is known as Bulletin 15.

THE INGERSOLL-RAND CO., New York, has issued a very attractive catalog on its products. This catalog gives a general idea of the numerous products manufactured by the company. For easy reference the products have been subdivided into various classifications. Particular attention is called to the Engineering Data Section, which is of value in solving everyday pneumatic problems, and in determining exact requirements for new equipment.

Industrial Notes

THE ENGINEERING ADVERTISERS' ASSOCIATION, Chicago, has proposed, and the Technical Publicity Association of New York has seconded, the proposal to hold an industrial advertising conference with the Associated Advertising Clubs of the World, meeting in Milwaukee in 1922. Both the Chicago and New York advertising associations have a large membership representing industrial and technical advertisers. The rapid growth of this kind of advertising and the necessity for specialist treatment in its development make it necessary to consider the subject apart from the usual question pertaining to advertising, and accordingly a special program for industrial advertising is proposed for the Milwaukee convention. The conference will serve an important purpose in suggesting new subjects for thought and investigation by advertising agencies.

THE GASOLINE RECOVERY CORP., New York, announces that a commercial natural gas gasoline plant operating according to the Burrell-Oberfell charcoal process is in operation at Bradford, Pa. The plant has a capacity of 900 gal. per day. It is also announced that the charcoal gasoline plant of the Monroe-Louisiana Carbon Co., located at Monroe, La., is nearing completion.

THE SCHAFFER ENGINEERING & EQUIPMENT CO., Pittsburgh, Pa., announces the combining of the administrative, sales and manufacturing departments in its new general offices at 2828 Smaliman St., Pittsburgh, Pa.

THE COCHRANE STEAM SPECIALTY CO. OF MASSACHUSETTS has been organized to represent in New England a number of well-known manufacturers of power-plant equipment, including the H. S. B. W.-Cochrane Corp., manufacturer of feed water heaters, steam and oil separators, V-notch meters and metering heaters, hot and cold process softeners, flow meters, precision meters, weighing meters, multiport valves and multiport drainers, also the Steam Motors Co., Inc., manufacturer of steam turbines for driving generators, pumps, fans, etc., and the D. Connelly Boiler Co., builder of water tube steam boilers. The office at 1045 Oliver Bldg., Boston, Mass., is in charge of Elliott Greene.

THE LINK-BELT CO., Chicago, has acquired all of the capital stock of the H. W. Caldwell & Son Co., and Frank C. Caldwell has been elected a director of the Link-Belt Co. The H. W. Caldwell & Son Co.'s plant will continue to operate under separate corporate existence under its present name.

THE SULLIVAN MACHINERY CO., Chicago, Ill., has moved its Cleveland office from 810 Park Bldg., to Room 824, Kirby Bldg. Ralph T. Stone is manager. It is also announced that a supply depot and service station for coal-mining machinery supplies and repair parts has been opened at Seventh Avenue and Thirteenth Street, Terre Haute, Ind. H. T. Wiley is in charge.

CHARLES CORY & SON, INC., 183-187 Varick St., New York City, has obtained the manufacturing and selling rights for the Royer line of portable and stationary flow indicators. These indicators are designed for indicating the flow of all kinds of corrosive and non-corrosive gases, vapors and liquids and were formerly manufactured and sold by the A. H. Sloan Co. of Detroit, Mich. It is intended, through the increased manufacturing facilities provided by the Cory company, to increase the production of these meters and make further extensions to the Royer line.

THE MALCOLMSON ENGINEERING CO. has just finished the peat harvesting machinery for the Dominion Government Peat Committee at Alfred, Ont. This involves equipment for excavating the peat from the ground and distributing it in piles for air-drying, when it is later picked up ready for the market.

THE MALCOLMSON ENGINEERING & MACHINE CORP., Old Colony Bldg., Chicago, Ill., has just completed the plant of the Tennessee-Illinois Phosphate Co., at Centreville, Tenn.

CASE SERVICE, INC., District National Bank Bldg., Washington, D. C., is an organization conducted for the purpose of serving non-residents of Washington, who have relations with various branches of the Government. It is designed to expedite business through personal attention.

C. W. LEAVITT & CO., New York, have been appointed selling agents in the United States for Mines de Manganese, Marquesa-Baja, Chile, producer of high-grade manganese ore. New equipment now being installed at the mines will place that company in a position to ship up to 300,000 tons manganese ore per annum.

New Publications

BOOKS

TECHNOLOGY OF CELLULOSE ESTERS, VOL. I, in five parts. By *Edward Chauncey Worden, First.* Pp. 3,709; 296 illustrations. New York: D. Van Nostrand Co., 1921. Price, $40.

Those interested in the subject of nitrocellulose and other cellulose esters are familiar with the author's earlier two-volume "Nitrocellulose Industry" and with Vol. VIII of this series on cellulose esters, which deals with cellulose acetate. The volume just issued represents the combined efforts of a number of workers over a period of years. Some idea of the labor involved may be gained from the fact that there are 19,611 footnotes covering 39,458 patent and 80,504 literature references to the work of 33,740 investigators. Part 1 treats the raw materials cellulose, starch, cotton and the preparation of cotton for esterification; part 2, nitric acid, sulphuric acid and mixed acids; part 3, nitrocellulose theory, nitration of cellulose, analytical determinations of the cellulose nitrates; part 4, historical development of the cellulose esters. Part 5 is the patent, name and subject index to the first four parts.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Vol. XIII, Part I, 1920. Pp. 463, illustrated. New York: D. Van Nostrand Co., 1921. Price, $6.

This volume contains the papers presented at the Montreal meeting, June, 1920.

A DICTIONARY OF APPLIED CHEMISTRY, Vol. II, revised and enlarged edition. By *Sir Edward Thorpe*, assisted by eminent contributors. Pp. 717, illustrated. London and New York: Longmans, Green & Co., 1921. Price, $20.

This volume of the revised and enlarged edition covers topics from calcusol to explosn, gaseous. Some of the more important articles are as follows: Camphor, Candles, Carbohydrates, Carbon, Cellulose, Cement, Chemical Affinity, Chlorine, Chromium, Cinchona Alkaloids, Citric Acids, Clay, Cobalt, Coke Manufacture and the Recovery of Byproducts, Colloids, Colorimeters, Color and Chemical Constitution, Copper, Corrosion of Metals, Corrosion (Protection of Metals From), Corrosion and Fouling of Steel and Iron Ships and Its Prevention, Creosote, Cyanides, Decolourising Carbons, Desiccation and Drying, Diazo-Compounds, Disinfectants, Distillation, Dyeing, Dyestuffs (Identification on Fabrics), Electrodeposition and Electroplating, Esterification, Ethyl, Evaporation, Explosion (Gaseous).

AMERICAN SULPHURIC ACID PRACTICE. By *Philip DeWolf* and *E. L. Larison*. Pp. 270; 85 illustrations. New York: McGraw-Hill Book Co., Inc., 1921. Price, $3.50.

This is the first book to deal with modern American sulphuric acid practice from the point of view of actual plant operation. It is designed to meet the needs of, say, a new chamber operator or of men in allied lines who wish to acquaint themselves quickly with the subject. After introductory chapters on the history of the industry, elementary chemistry of H_2SO_4, characteristics and uses, the raw materials and the production of SO_2 are discussed. The chamber process is treated in the following chapters: A brief description of the process, dust-settling apparatus, the Glover tower, the chambers, Gay-Lussac towers, acid circulation, introduction of niter, draft, testing, operation, concentration. An outline of the contact process is followed by chapters on purification of gases, converting, absorption, and converter mass. A special chapter on accounting was prepared by W. M. Le Clear. Acid tables, data for calculating the volume of acid in tank cars, etc., are given in the appendix.

THE ELECTRIC FURNACE. By *J. N. Pring, D.Sc.* Pp. 485; 241 illustrations. London and New York: Longmans, Green & Co., 1921. Price, $10.50.

Practically all electrochemical and electrometallurgical process in which the electric current functions as a source of heat energy are included in this book, which is one of the monographs on industrial chemistry edited by Sir Edward Thorpe. Electrolysis in aqueous solutions is outside the scope of the text, although the electrodeposition of zinc and copper is referred to briefly. The electrochemical industries include calcium carbide, nitrogen fixation and ammonia oxidation, carborundum, alundum, graphite, phosphorus, carbon bisulphide, electrolytic processes with fused electrolytes (aluminum, sodium and calcium). The electrometallurgical industries are the electric smelting of iron ores, electric steel, ferro-alloys, melting and preparation of non-ferrous metals and alloys, electric smelting of zinc, copper and tin ores. There are also general chapters on the principles of electric furnaces, laboratory and experimental types, current supply, transformers, pyrometry, refractories, heat losses through walls and electrodes, design of terminals, power expenditure, water-power developments, steam-power stations and electrochemical centers. In short, electric furnaces and their industrial applications are very thoroughly covered.

CERAMICS. By *A. Malinovzsky*. Pp. 274, illustrated. New York: D. Van Nostrand Co., 1921. Price, $3.

A condensed review of ceramic processes, including the methods of qualitative and quantitative analysis of silicates, and chemical and ceramic calculations used in everyday practice. Many tables which will be helpful to the ceramic engineer are also included.

METALLURGY OF THE COMMON METALS. Fifth edition. By *Leonard S. Austin*, formerly professor of metallurgy and ore dressing, Michigan College of Mines. Pp. 615; 330 illustrations. New York: John Wiley & Sons, Inc., 1921. Price, $7.

Since 1913, the date of the last edition, such radical changes and improvements have been made in the metallurgy of the common metals that this edition has been largely rewritten. Great pains have been taken to set forth underlying principles clearly and at the same time to give the details of methods and metallurgical equipment, and their cost. A chapter has been devoted to questions of the economic situation of the business of metallurgy. Little attempt has been made to describe methods not now in use.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold its seventy-fourth meeting at Toronto, Canada, Dec. 27 to 31, 1921.

AMERICAN CERAMIC SOCIETY will hold its twenty-first annual meeting at St. Louis, Feb. 27 to March 2, 1922.

AMERICAN GAS ASSOCIATION will hold its third annual convention in the Congress and Auditorium Hotels, Chicago, the week of Nov. 7. More than 100 manufacturers will exhibit their latest gas-burning appliances.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Lake Placid, N. Y., Sept. 29 and 30, and Oct. 1.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its annual winter meeting at Baltimore, Md., Dec. 6 to 9. Headquarters will be at the Southern Hotel and the sessions will be held in the Engineers' Club.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS is holding its fall meeting at Wilkes-Barre, Pa., Sept. 12 to 17.

AMERICAN MINING CONGRESS AND NATIONAL EXPOSITION OF MINES AND MINING EQUIPMENT will hold its twenty-fourth annual convention in the Coliseum, Chicago, Oct. 17 to 22.

AMERICAN SOCIETY FOR STEEL TREATING will hold its third annual convention and exhibition Sept. 19 to 24 at Indianapolis.

THE NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SEVENTH) is being held this week in the Eighth Coast Artillery Armory, New York City.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer and will resume them in October.

SOCIETY OF INDUSTRIAL ENGINEERS will hold its fall meeting at Springfield, Mass., Oct. 5 to 7.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY will hold its fall convention with the American Pulp and Paper Mill Superintendents' Association, at Washington, Philadelphia, Spring Grove, York, York Haven, Pa., and Wilmington, Del., Oct. 18 to 20.

The following meetings are scheduled to be held in Rumford Hall, the Chemists' Club, New York: Oct. 7—American Chemical Society, regular meeting; Oct. 14—Société de Chimie Industrielle, regular meeting; Oct. 21—Society of Chemical Industry, Grasselli Medal; Nov. 11—American Chemical Society (in charge), Society of Chemical Industry, American Electrochemical Society, Société de Chimie Industrielle, joint meeting; Nov. 18—American Electrochemical Society, regular meeting; Dec. 2—Society of Chemical Industry, regular meeting; Dec. 9—American Chemical Society, regular meeting.